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14. ABSTRACT Purpose: This report outlines progress made during the first year of the "Risk Factors for Discharge from the Army with a Permanent Disability" research project. Scope: The study's overall goal is to identify factors associated with the Army's rapidly increasing disability discharges rates in order to develop targeted and cost-efficient disability reduction strategies. We hypothesize that disability is the result of a combination of health, occupational, and personal risk factors that can be identified prior to the onset of a potentially disabling condition. It is further hypothesized that many of these factors are modifiable. With appropriate identification and intervention, disability among at-risk soldiers can be prevented. Major Findings to date: Underlying Army demographic changes over time do not explain the overall increases in disability rates. While increases in disability are generally experienced across all military demographic groups, fastest growing rates were observed among women, junior enlisted, younger soldiers and those without college degrees. The primary cause of increasing disability and disability overall is the adverse effects of acute and chronic injury. More research is needed to understand the etiology of these conditions and should include multivariate predictive models to assess independent effects of gender, education, rank and age.

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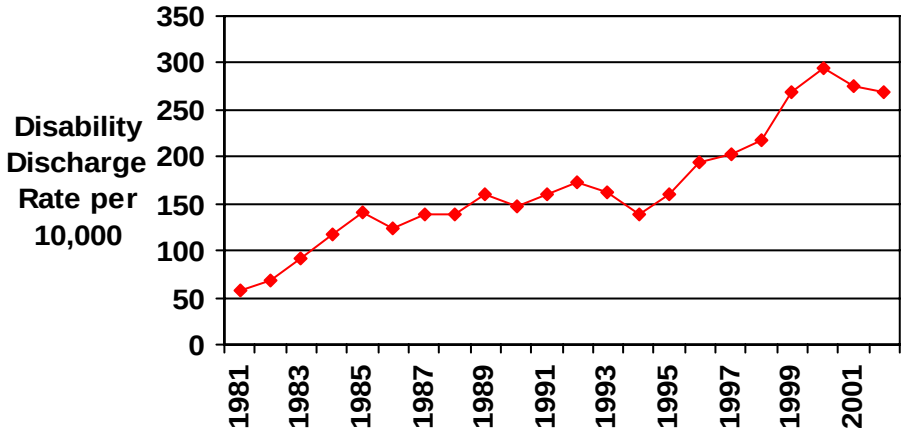
INTRODUCTION

This report outlines progress made during the first year of the "**Risk Factors for Discharge from the Army with a Permanent Disability**" research project. The overall goal of this project is to describe disability, including temporal trends in disability rates and the profile of those who experience disability, and in the process begin to uncover the underlying causes or factors contributing to disability among US Army soldiers. A major aim is to identify factors associated with an increased risk for medical disability discharges or retirement with a disability from the Army in order to develop targeted and cost-efficient disability reduction strategies. We hypothesize that disability is the result of a combination of health, occupational, and personal demographic or behavioral risk factors which can be identified prior to the onset of a potentially disabling condition. This information can then be used to refine or create intervention strategies to reduce the burden of disability.

BACKGROUND

Disability is a large and growing problem in both the military and civilian populations within the United States today. Among working-age civilians, the rate of persons receiving benefits for a permanent disability rose approximately 40% between 1990 and 1999 (11). The prevalence of permanent disability within the active duty Army population has risen even more sharply. According to one source, between 1981 and 2001, the rates of temporary and permanent medical disability in active duty Army personnel have increased 460%, from just under 50 per 10,000 soldiers to slightly less than 300 per 10,000 soldiers (Figure 1). In 2003 alone, the Army experienced approximately 5,000 separations and 56,000 retirements due to a medical disability (7).

Figure 1. Rates of temporary and permanent disability in active duty Army personnel, 1981-2001.



Source: Amoroso P. What's Behind the Developing Epidemic of Musculoskeletal Disability in the U.S. Army? Presentation: USARIEM Environmental Medicine Course, May 7, 2004.

The costs of occupational disability are staggering. In 1993, medical expenses related to disabilities in the civilian population were estimated at approximately $283 million. Per capita medical expenses for adults in their prime working years (age 18 – 44) were three times greater for those with a disability than for the non-disabled population of the same age (13). Public benefits for all disabled persons in the United States, excluding worker compensation payments, amounted to almost $3 billion in 1999 (15).

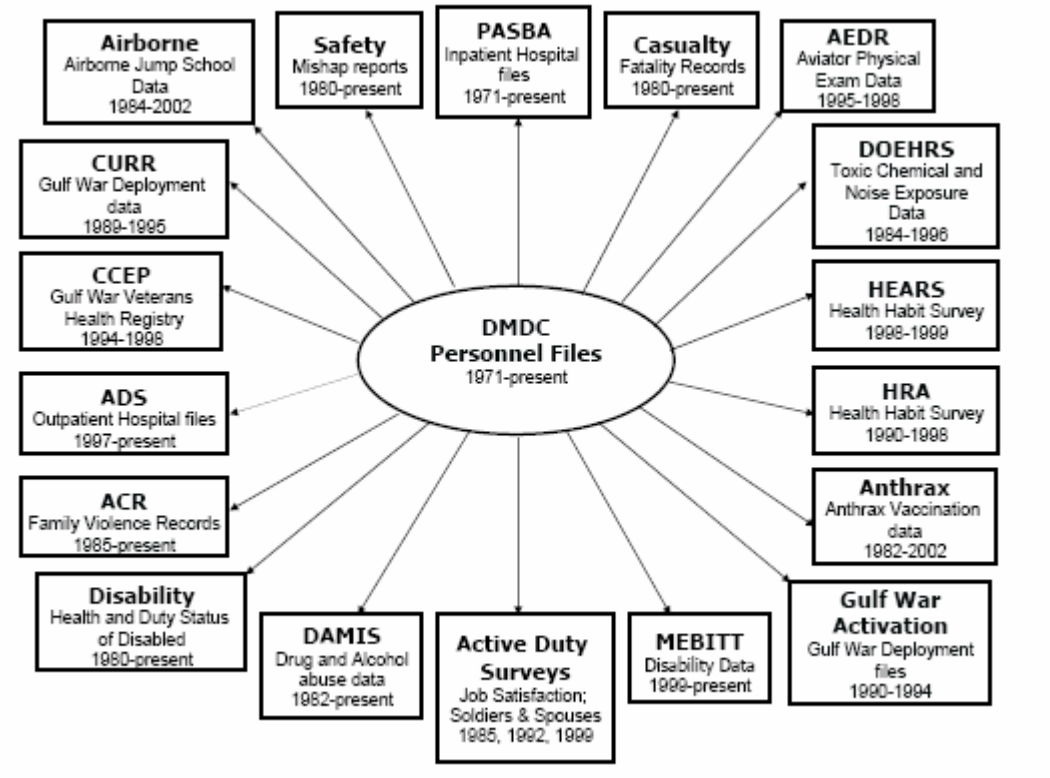
The economic costs to the military are even greater. In 2003, the DoD paid $425 million in disability benefits to soldiers found unfit for service. The Department of Veterans Affairs (VA) estimated disability payments of over $21 billion in 2002. When VA disability benefits are offset by regular earned retirement pay, the total disability benefits disbursed by the military in 2002-2003 are approximately $18.5 billion (1). While the total medical care costs for disabled Army soldiers are unknown, VA facility treatment costs for those with a medical discharge between 1986 and 1995 were estimated at approximately $124 million in 2001 alone (1). These costs are only part of the picture. Reductions in work productivity prior to disablement, wage losses of both the disabled individual and any caretakers, inability to perform household tasks, and decreased quality of life due to the disabling condition are not factored in to the costs of disability (10, 12). Recruitment and replacement training costs, as well as the costs due to the loss of experienced employees, are not estimated. Similarly, medical care for the condition prior to disablement and administrative costs associated with evaluating and processing the disability are unknown. Also unknown are the costs associated with the Army's investment in training and maintaining soldiers whose careers are cut short by a disability.

Between 1980 and 2002, the number of active duty Army personnel fell by 37% (6). This reduction in manpower implies that soldiers are becoming ever more important resources that may not be quickly or easily replaced in the event of a disability, affecting both the morale of the remaining troops and combat readiness (5). At the same time, it has been observed that the health-related quality of life (HRQL) of active duty soldiers, which includes perceptions of physical and mental health, stress, depression and anxiety, is lower than can be found in the civilian population (4); these factors may increase the risk for poor health and subsequent disability. The retention of soldiers is crucial, yet reasons for separation are poorly understood, leading the U.S. General Accounting Office (GAO) to recommend that the military collect better data on this issue (14). The importance of such data for the prevention of disability in active duty soldiers is clear.

This research draws upon data from the Total Army Injury Health Outcomes Database (TAIHOD) (2, 3). Established at the U.S. Army Research Institute of Environmental Medicine (USARIEM) in 1994 to specifically examine the impact of injury and disability outcomes among U.S. Army soldiers, the TAIHOD now contains electronic records for all soldiers who have been on active duty since 1971 (approximately 5 million individuals). These data sources, which are linked at the level of the individual soldier, contain information on disabilities, demographic and occupational

characteristics including job type, discharge from the Army and reason for separation, inpatient and outpatient health care utilization, health habit information and other health outcomes and conditions such as deaths, and treatment for alcohol or drug-related problems (see Figure 2).

Figure 2. Components of the Total Army Injury Health Outcomes Database (TAIHOD)



YEAR 1 STATEMENT OF WORK (SOW) PROGRESS

SUMMARY STATUS OF SOW PROGRESS

SOW TASK 1. SET UP COLLABORATOR AGREEMENTS

In this first year we have completed this task twice. We set up our initial collaborator agreements, obtained letters of support and took steps to insure that all collaborators received appropriate training in the proper use of data (human subjects training). In May of 2007 the original principal investigator, Dr. Carolyn Schwartz stepped down as PI and resigned her position at SSDS. Dr. Nicole Bell, who developed the original analytic plan for this project and established the research team leading the grant, took over as PI. Paperwork was submitted to make this change and is currently under review. After reviewing the work objectives and progress made during the year, Dr. Bell invited Dr. Jonathan Howland to join the team in order to help complete the products. She also asked Dr. Thomas Harford to increase his time in order to help complete the work. This considerably strengthens the research team and puts together an experienced group of scientists who have successfully worked together on other projects. A letter of support from Dr. Howland was solicited, obtained and included in the change of PI package submitted to the U.S. Army Medical Research and Material Command. In addition, appropriate steps have been taken to insure continued human use oversight. The USARIEM human use review committee approved our proposed change in Principal Investigator as well as the addition of Dr. Howland as a consultant on 18 July 2007.

SOW TASK 2. UPDATE DATABASES AND CLEAN/TEST

A. Disability Files

Extensive work has taken place to update files from the US Army Physical Disability Agency so that the files can be utilized for research purposes. At the start of this research grant, the TAIHOD contained disability data up to 2002. SSDS

Programmers performed rigorous data processing and validation so that more current disability data could be used in research efforts. Disability information is now available for active-duty Army soldiers through 2005 and we will continue to add more data as they become available.

Interpreting disability data is particularly challenging because Soldiers placed on TDRL may remain in that status for up to 5 years before a final disposition is reached. Once defined as a TDRL case, the Soldier may later be found fit for duty, remain as a TDRL case, or be retired with or without a disability rating. Some of these individuals never return for re-evaluation, they just let their benefits run out and neither return to duty nor become permanently retired. The database contains multiple records pertaining to continuing evaluations, which reflect changes in the Soldier's disability status. As a result of these challenges, extra care has been taken to insure that we have successfully identified unique records of repeating events (as opposed to duplicate records for a single event).

B. Inpatient Hospitalization Records

In anticipation of upcoming papers in Year 2 of this grant, we have devoted time to updating and improving the TAIHOD's inpatient hospitalization files. Inpatient hospitalization data are received from two disparate sources and SSDS programmers had to combine these separate data files through a series of programming endeavors and data manipulation. Once the files were combined, the information was validated, checked for accuracy and duplicates were eliminated.

In addition, SSDS programmers developed ways to make research involving hospitalization data more reliable. The entire TAIHOD inpatient hospitalization files were reconstructed from raw data. Coding algorithms were developed, verified and implemented. We are confident that the resulting inpatient hospitalization files within the TAIHOD will yield more robust results.

C. Outpatient Hospitalization Records

As with the inpatient hospitalization files, outpatient hospitalization files were also updated so that they can be used for future research endeavors supported by this grant. Due to the Army's record-keeping system and the shift in recent years towards outpatient care, outpatient hospital data are also received from several sources. Data from these disparate data agencies must be merged and then validated for research purposes. SSDS programmers have been able to update the outpatient hospitalization through 2005 over the past year.

D. Personnel Files

All papers promised in this grant depend upon accurate and updated personnel data for active-duty Army soldiers. As such, programmers must continually update personnel files obtained through the Defense Manpower Data Center. These data must be integrated into the TAIHOD, checked for accuracy and duplicates, and validated for research purposes. Personnel files in the TAIHOD are now updated through 2006 as a result of work efforts over the past year.

E. Army Discharge (Loss) Files

Our Army discharge ("Loss") files have also been updated this past year and are now current through 2006. These files, which contain data on discharge circumstances (reason for and type of discharge) as well as date of discharge, have been incorporated into the TAIHOD and now can be linked to all other existing databases. The accurate recording of loss data is crucial to the determination of rates (population denominators) and in assessing risk for discharge from the Army.

SOW TASK 3. MOS CROSSWALK CONSTRUCTION

An assessment of the link between occupational exposures and subsequent disability requires the creation of a crosswalk to correctly identify and follow occupational exposures across time. In addition, the crosswalk is necessary as part of the process of linking data on physical demands associated with various occupations to disability. This MOS crosswalk is a SOW objective for year 1 and a key component of our third paper (promised in Year 2). There are two challenges related to this task: First, the primary means of assessing job type, Military Occupational Specialties (MOS), changes over time in unpredictable ways (e.g., a given job type might at some point be assigned a different code and the old code assigned to an entirely new job or simply dropped; occupational specialties also change over time as some jobs become obsolete or new jobs are added); Second, the scale developed by the Department of the Army Headquarters to rate MOSs according to how physically demanding they are (9) is not available as an electronic database. Thus, data on each specific MOS has to be located and hand-entered, which is a very time-consuming, but necessary, task for any large-scale analyses. In addition, physical job demands data have not been updated since the report was commissioned in 2000. Thus, a crosswalk that allows us to follow MOSs from the year in which the physical demands scale was created to comparable MOSs prior to and after that year is needed. To date, over 1,200 enlisted MOS codes have been used to denote enlisted military occupations.

Job demand information is only reliably available for enlisted occupational specialties so analyses excluded jobs only open to officers. Physical job demands are available in Army Regulation (AR) 611-21, published in 1999 (8). The job demands scale is ordered from light physical demand to very heavy physical demand with five categories: light, medium, moderately heavy, heavy and very heavy. Demand levels are assigned according to the amount of lifting required for a specific occupation:

Light	Lift on an occasional basis a maximum of 20 pounds with frequent or constant lifting of 10 pounds
Medium	Lift on an occasional basis a maximum of 50 pounds with frequent or constant lifting of 25 pounds
Moderately Heavy	Lift on an occasional basis a maximum of 80 pounds with frequent or constant lifting of 40 pounds
Heavy	Lift on an occasional basis a maximum of 100 pounds with frequent or constant lifting of 50 pounds
Very Heavy	Lift on an occasional basis over 100 pounds with frequent or constant lifting in excess of 50 pounds

We consulted with Dr. Marilyn Sharp at USARIEM, an expert in MOS physical demand classification, regarding an appropriate approach to collapse the five physical demand categories. She suggested a 3-level grouping based on her experience rating the physical demands of various MOSs. Light and medium physically-demanding jobs were collapsed as “light;” moderately heavy remained as its own category (“moderate”); and, heavy and very heavy physically-demanding jobs were collapsed into “heavy.”

We selected all MOS codes in 2000 (the year in which the most current AR 611-21 physical demands ratings were presumably in effect) and rank ordered them by frequency from largest to smallest. Military occupations that were eliminated or obsolete by 2000 were therefore not represented. Then, in order to have a reasonable sample of large MOSs within all levels of physical demands, we hand coded these jobs according to the AR 611-21 physical demand ratings. We continued until we had 15 MOSs within each of the three physical demand categories: heavy, moderate and light (comprising 63% of the total population). Table 1 shows the top 15 most common heavy, moderate and light physically-demanding jobs among enlisted Army soldiers in 2000. Of the top 50 most common MOS codes in 2000, 62% (N=31) were of heavy physical demand, 26% (N=13) were moderate, and 8% (N=4) were of light physical demand. Six MOS codes (12%) were not assigned a physical demand rating in the AR 611-21.

Table 1. Crosswalk of Military Occupational Specialties with Level of physical demand, 2000 (N=486,328).

Military Occupational Specialty	Physical Demands	Male only	Frequency (2000)	Percent of total (2000)
Heavy/Very Heavy Demands Jobs				
11B Infantryman	Heavy	X	32,651	6.71%
11M Fighting Vehicle Infantryman*1981	Heavy	X	15,688	3.23%
92A Automated Logistical Specialist*1992	Heavy		15,202	3.13%
92Y Unit Supply Specialist	Heavy		15,142	3.11%
88M Motor Transport Operator	Heavy		13,805	2.84%
19K M1 Armor Crewman	Heavy	X	12,996	2.67%
63B Light-wheel Vehicle Mechanic	Heavy		12,953	2.66%
13B Cannon Crewmember	Heavy	X	11,929	2.45%
12B Combat Engineer	Heavy	X	11,643	2.39%
92G Food Service Operations*1995	Heavy		11,330	2.33%
77F Petroleum Supply Specialist	Heavy		9,473	1.95%
19D Cavalry Scout	Heavy	X	9,117	1.87%
54B Chemical Operations Specialist*1987	Heavy		7,511	1.54%
31R Multichannel Transmission System Operator/Maintainer	Heavy		7,509	1.54%
11C Indirect Fire Infantrymen	Heavy	X	5,985	1.23%
Moderate Demands Jobs				
91B Medical Specialist	Moderate		18,706	3.85%
95B Military Police	Moderate		16,016	3.29%
31U Signal Support Systems Specialist	Moderate		9,468	1.95%
75H Personnel Services Specialist	Moderate		8,907	1.83%
75B Personnel Administration Assistant	Moderate		4,368	0.90%
13M Multiple Rocket Launch System Crewmember	Moderate	X	3,537	0.73%
14T PATRIOT Launching Station Enhanced Operator/Maintainer	Moderate		2,806	0.58%
98C Signals Intelligence Analyst	Moderate		2,548	0.52%
74C Telecommunications Operator-Maintainer	Moderate		2,311	0.48%
31S Satellite Communications Systems Operator-Maintainer	Moderate		2,222	0.46%
91K Medical laboratory Specialist	Moderate		2,150	0.44%
67R AH-64 Attach Helicopter Repairer	Moderate		2,146	0.44%

35E Radio and Communications Security Repairer	Moderate		2,097	0.43%
88N Transportation Management Coordinator	Moderate		1,970	0.41%
31P Microwave Systems Operator-Maintainer	Moderate		1,798	0.37%
Light/Medium Demands Jobs				
71L Administrative Specialist	Light		11,688	2.40%
96B Intelligence Analyst	Light		4,508	0.93%
73C Finance Specialist	Light		2,360	0.46%
93P Aviation Operations Specialist	Light		2,176	0.45%
71D Legal Specialist	Light		1,865	0.38%
97B Counterintelligence Agent	Light		1,766	0.36%
76J Medical Supply Specialist	Light		1,669	0.34%
14R BRADLEY Linebacker Crewmember	Light	X	1,488	0.31%
14E PATRIOT Fire Control Enhanced Operator Maintainer	Light		1,419	0.29%
91D Operating Room Specialist	Light		1,280	0.26%
33W Electronic Warfare/Intercept Systems Repairer	Light		1,221	0.25%
96D Imagery Analyst	Light		1,084	0.22%
71G Patient Administration Specialist	Light		1,075	0.22%
97E Human Intelligence Collector	Light		940	0.19%
91S Preventive Medicine Specialist	Light		775	0.16%

We also examined the top 15 light, moderate and heavy physically-demanding military occupations separately for male and female soldiers in 2000. Out of the top 50 MOS codes for enlisted male soldiers, 35 (70%) were of heavy physical, 11 (22%) were moderate, 2 (4%) were low and 2 (4%) were assigned "N/A." Out of the top 50 female MOS codes, 20 (60%) were heavy, 18 (36%) were moderate, 11 (22%) were low physical demand and 1 (2%) was assigned "N/A." Tables 2 and 3 list the most common MOS codes for males and females, respectively. While the proportions varied slightly, the most common heavy, moderate and light physically-demanding occupations for men were equivalent to the most common occupations of the entire Army with the exception of Utilities Equipment Repairer (one of the top 15 moderately heavy occupations) and Psychological Operations Specialist (one of the top 15 light physical demand male occupations). Since some of the common occupations for the entire Army are restricted to males only, the profile of the most common heavy, moderate and light physically demanding occupations among women differed somewhat from the top 15 male jobs. Commonly held heavy jobs for women in 2000 included Voice Interceptor, Ammunition Specialist, Network Switching Systems Operator-Maintainer, Cargo Specialist, Cable Systems Installer and Light-wheeled Mechanic. Commonly held moderate jobs for women in 2000 included Dental Specialist, Radiology Specialist, Chaplain's Assistant,

Personnel Information System Management Specialist and Veterinary Food Inspection Specialist. Light occupations in the top 15 most common among females distinct from the top 15 of the entire Army population were Accounting Specialist, Signals Collection/Identification Analyst and Journalist.

Table 2. Crosswalk of Military Occupational Specialties with Level of physical demand among male enlisted Army soldiers, 2000 (N=408,245).

Military Occupational Specialty	Physical Demands	Frequency (2000)	Percent of total males (2000)
Heavy/Very Heavy Demands Jobs			
11B Infantryman	Heavy	32,611	7.99%
11M Fighting Vehicle Infantryman	Heavy	15,672	3.84%
19K M1 Armor Crewman	Heavy	12,985	3.18%
13B Cannon Crewmember	Heavy	11,926	2.92%
63B Light-wheel Vehicle Mechanic	Heavy	11,761	2.88%
12B Combat Engineer	Heavy	11,634	2.85%
88M Motor Transport Operator	Heavy	10,875	2.66%
92Y Unit Supply Specialist	Heavy	10,076	2.47%
92A Automated Logistical Specialist	Heavy	9,342	2.29%
19D Cavalry Scout	Heavy	9,115	2.23%
92G Food Service Operations	Heavy	8,220	2.01%
77F Petroleum Supply Specialist	Heavy	7,062	1.73%
31R Multichannel Transmission System Operator/Maintainer	Heavy	6,620	1.62%
54B Chemical Operations Specialist	Heavy	6,005	1.47%
11C Indirect Fire Infantrymen	Heavy	5,980	1.46%
Moderate Demands Jobs			
95B Military Police	Moderate	13,433	3.29%
91B Medical Specialist	Moderate	12,928	3.17%
31U Signal Support Systems Specialist	Moderate	8,431	2.07%
75H Personnel Services Specialist	Moderate	5,471	1.34%
13M Multiple Rocket Launch System Crewmember	Moderate	3,535	0.87%
75B Personnel Administration Assistant	Moderate	2,688	0.66%
14T PATRIOT Launching Station Enhanced Operator/Maintainer	Moderate	2,275	0.56%
31S Satellite Communications Systems Operator-Maintainer	Moderate	2,065	0.51%
67R AH-64 Attach Helicopter Repairer	Moderate	2,000	0.49%
98C Signals Intelligence Analyst	Moderate	1,922	0.47%
35E Radio and Communications Security Repairer	Moderate	1,849	0.45%

31P Microwave Systems Operator-Maintainer	Moderate	1,574	0.39%
74C Telecommunications Operator-Maintainer	Moderate	1,537	0.38%
52C Utilities Equipment Repairer	Moderate	1,376	0.34%
88N Transportation Management Coordinator	Moderate	1,329	0.33%
Light/Medium Demands Jobs			
71L Administrative Specialist	Light	5,692	1.39%
96B Intelligence Analyst	Light	3,853	0.88%
93P Aviation Operations Specialist	Light	1,510	0.37%
14R BRADLEY Linebacker Crewmember	Light	1,484	0.36%
97B Counterintelligence Agent	Light	1,411	0.35%
14E PATRIOT Fire Control Enhanced Operator Maintainer	Light	1,309	0.32%
73C Finance Specialist	Light	1,289	0.32%
71D Legal Specialist	Light	1,138	0.28%
33W Electronic Warfare/Intercept Systems Repairer	Light	1,114	0.27%
76J Medical Supply Specialist	Light	972	0.24%
96D Imagery Analyst	Light	808	0.20%
91D Operating Room Specialist	Light	758	0.19%
97E Human Intelligence Collector	Light	677	0.17%
71G Patient Administration Specialist	Light	569	0.14%
37F Psychological Operations Specialist	Light	559	0.14%

Table 3. Crosswalk of Military Occupational Specialties with Level of physical demand among female enlisted Army soldiers, 2000 (N=77,505).

Military Occupational Specialty	Physical Demands	Frequency (2000)	Percent of total females (2000)
Heavy/Very Heavy Demands Jobs			
92A Automated Logistical Specialist	Heavy	5,860	7.56%
92Y Unit Supply Specialist	Heavy	5,066	6.54%
92G Food Service Operations	Heavy	3,110	4.01%
88M Motor Transport Operator	Heavy	2,929	3.78%
77F Petroleum Supply Specialist	Heavy	2,411	3.11%
54B Chemical Operations Specialist	Heavy	1,506	1.94%
74B Information Systems Operator-Analyst	Heavy	1,231	1.59%
63B Light-wheel Vehicle Mechanic	Heavy	1,191	1.54%
98G Voice Interceptor	Heavy	1,116	1.44%
31R Multichannel Transmission System Operator-Maintainer	Heavy	889	1.15%
55B Ammunition Specialist	Heavy	819	1.06%
31F Network Switching Systems Operator-	Heavy	592	0.76%

Maintainer			
88H Cargo Specialist	Heavy	577	0.74%
31L Cable Systems Installer-Maintainer	Heavy	553	0.71%
63W Wheel Vehicle Repairer	Heavy	475	0.61%
Moderate Demands Jobs			
91B Medical Specialist	Moderate	5,778	7.46%
75H Personnel Services Specialist	Moderate	3,436	4.43%
95B Military Police	Moderate	2,583	3.33%
75B Personnel Administration Assistant	Moderate	1,679	2.17%
31U Signal Support Systems Specialist	Moderate	1,037	1.34%
91K Medical laboratory Specialist	Moderate	903	1.17%
74C Telecommunications Operator-Maintainer	Moderate	774	1.00%
91E Dental Specialist	Moderate	733	0.95%
88N Transportation Management Coordinator	Moderate	641	0.83%
98C Signals Intelligence Analyst	Moderate	625	0.81%
14T PATRIOT Launching Station Enhanced Operator/Maintainer	Moderate	531	0.69%
91P Radiology Specialist	Moderate	425	0.55%
71M Chaplain's Assistant	Moderate	405	0.52%
75F Personnel Information System Management Specialist	Moderate	369	0.48%
91R Veterinary Food Inspection Specialist	Moderate	337	0.43%
Light/Medium Demands Jobs			
71L Administrative Specialist	Light	5,996	7.74%
73C Finance Specialist	Light	971	1.25%
96B Intelligence Analyst	Light	925	1.19%
71D Legal Specialist	Light	727	0.94%
76J Medical Supply Specialist	Light	697	0.90%
93P Aviation Operations Specialist	Light	666	0.86%
91D Operating Room Specialist	Light	522	0.67%
71G Patient Administration Specialist	Light	506	0.65%
97B Counterintelligence Agent	Light	355	0.46%
96D Imagery Analyst	Light	276	0.36%
73D Accounting Specialist	Light	272	0.35%
97E Human Intelligence Collector	Light	263	0.34%
91S Preventive Medicine Specialist	Light	257	0.33%
98K Signals Collection/Identification Analyst	Light	198	0.26%
46Q Journalist	Light	184	0.24%

The second step of our crosswalk was to calculate the average frequency and percent of the total enlisted Army population over time within the selected MOSs. In order to do this, we needed to quantify the frequency of each occupation over each year

of the study period which required the construction of a crosswalk for each individual MOS occupation over time. Since MOS codes are often changed, eliminated or recycled we had to carefully follow each occupation from 2000 through 2003 (the last year in which the TAIHOD has complete MOS data). We also had to meticulously trace each occupation through coding and occupational name changes back to 1980. We relied on multiple sources of information including a military occupational coding expert at the Defense Manpower Data Center (DMDC), and MOS tables referred to as Conversion Tables provided by DMDC. These conversion tables were not designed to convert occupations over time but rather to document years in which a certain MOS code was assigned to a certain occupation. Identification of coding changes and MOS titles thus required a very complex series of research, programming and data checks to identify the proper related MOS codes over a 24 year period and link them together. We crosswalked the top 15 heavy, moderate and light MOS codes for the entire enlisted Army from 2000 listed in Table 1.

In tracking these codes and their related codes over time, we learned that some of the common occupations in later years did not exist in earlier years. For example, among the 15 most common heavy occupations in 2000, we found that specific occupations of 11M, 19K, 92A, 92G and 54B were not populated throughout the entire study period. When these or similar coding anomalies occurred, we calculated average frequencies and average percents of the total population only using the years when these codes were in use. These codes are marked by an asterisk in Table 4 along with information regarding the years in which they were available. It is possible that these codes represent newly-added occupations within the military that did not exist in prior years. It is also possible, however, that these occupations did exist but that we have been unable to track down either their predecessors or successors in the MOS coding system. We will continue to investigate such codes to strengthen future projects that will rely on this crosswalk.

Our research revealed that of the 45 occupations, 16 of the codes used in 2000 had been assigned different MOS codes throughout our study period. For example, a Petroleum Supply Specialist was assigned 77F from April 1986 to September 2003 and then assigned 92F from September 2003 forward. In some cases, we found evidence suggesting that the conversion table was incomplete. For example, the conversion tables indicate that MOS code 76W was used from 1967 to 1993, resulting in an overlap with 77F. However, further analysis of annual frequencies revealed that 76W was phased out of use beginning in 1986 and not 1993 as indicated in the conversion table. In any case, all three codes needed to be crosswalked to capture any soldier who spent time as a Petroleum Supply Specialist over the study time period.

In some cases, the evolution of codes made tracking an occupational group across time quite complicated. For example, in 2000, MOS code 54B was assigned to Chemical Operations Specialist. This code was used for this occupation from October 1987 through September 2003. However, prior to this time, the alphanumeric code “54B” had been used to denote a Decontamination Specialist. After September 2003, Chemical Operations Specialists were given code 74D for their military occupation to

replace 54B. Yet, from 1965 to April 1995 74D was used for an Information Systems Operator. When an MOS code has been recycled, as in this case, we have to interpret codes in the context of date parameters. For another example, 71D was assigned to Legal Assistant from May 1965 through April 2001. Also, from October 2000 forward, 27D denoted paralegal Assistant. Since 71D ended, we believed that Legal and Paralegal Assistant were synonymous even though the years the codes were implemented overlapped. Yet, code 27D referred to a LANCE Missile System Repairman from January 1967 to May 1977 and then to a ROLAND Repairer from September 1981 through October 1989. A LANCE Repairer was subsequently reassigned at various times to MOS codes 27L, 27E, 94A, 35A at times under a variation of the title. A ROLAND Repairer was also assigned different MOS codes throughout our study period. To first identify and then resolve these discrepancies and others that are similar, our programmer had to look at the distribution of each code over every year and then link them to the related codes over the proper time periods accordingly.

Table 4 below displays the results from the MOS crosswalk. Rough percentages are given based on the relative proportion of the total enlisted Army (N=15,546,521 from 1981-2003), total enlisted females throughout the study period (N=1,892,709 from 1981-2003) and total enlisted male population (N=13,641,473 from 1981-2003). As a result of the crosswalk, we are able to track occupations and more accurately capture frequencies of soldiers in these occupations over time. By using only a specific MOS code in a point in time for a given occupation, this opportunity would have been lost. This allows for larger occupational cohorts to examine certain risk factors and patterns of interest within the Army, especially among groups of different physical demand levels.

Table 4. Top 15 Military Occupations for light, moderate and heavy levels of physical demands, 1980-2003.

Military Occupational Specialty	Physical Demands	Total Army		Males		Females	
		Average Frequency	Average Percent	Average Frequency	Average Percent	Average Frequency	Average Percent
Heavy/Very Heavy Demands Jobs							
11B Infantryman	Heavy	53,209	8.13%	53,113	9.31%	--	--
13B Cannon Crewmember	Heavy	23,029	3.44%	23,002	3.93%	--	--
63B Light-wheel Vehicle Mechanic	Heavy	20,695	3.12%	19,201	3.30%	1,491	1.89%
92Y Unit Supply Specialist	Heavy	20,676	3.19%	16,181	2.80%	4,488	5.72%
88M Motor Transport Operator	Heavy	19,574	2.96%	16,940	2.89%	2.632	3.35%
92A Automated Logistical Specialist*1993-2003	Heavy	14,807	3.04%	9,490	2.29%	5,313	7.26%
12B Combat Engineer	Heavy	14,406	2.23%	14,389	2.56%	--	--
19K M1 Armor Crewman*1982-2003	Heavy	13,331	2.29%	13,316	2.65%	--	--
11M Fighting Vehicle Infantryman*1983-2002	Heavy	12,473	2.18%	12,450	2.52%	--	--
19D Cavalry Scout	Heavy	10,975	1.72%	10,961	1.97%	--	--
92G Food Service Operations*1995-2003	Heavy	10,640	2.25%	7,561	1.90%	3,078	4.16%
11C Indirect Fire Infantrymen	Heavy	9,555	1.44%	9,548	1.65%	--	--
77F Petroleum Supply Specialist	Heavy	8,968	1.49%	7,188	1.37%	1,778	2.30%
31R Multichannel Transmission System Operator/Maintainer	Heavy	8,398	1.32%	7,271	1.32%	1,126	1.41%
54B Chemical Operations Specialist*1987-2003	Heavy	8,132	1.44%	7,050	1.43%	1,080	1.42%
Moderate Demands Jobs							
95B Military Police	Moderate	23,894	3.67%	21,007	3.67%	2,883	3.66%
91B Medical Specialist*1981-2002	Moderate	17,028	2.77%	13,284	2.45%	3,740	4.88%

31U Signal Support Systems Specialist*1993-2003	Moderate	9,072	1.86%	8,121	1.96%	948	1.29%
75H Personnel Services Specialist*1996-2003	Moderate	8,060	1.71%	4,966	1.25%	3,093	4.18%
75B Personnel Administration Assistant	Moderate	6,161	0.95%	4,539	0.79%	1,650	2.09%
98C Signals Intelligence Analyst	Moderate	3,123	0.50%	2,332	0.43%	790	1.00%
13M Multiple Rocket Launch System Crewmember*1982-2003	Moderate	3,212	0.57%	3,209	0.67%	--	--
14T PATRIOT Launching Station Enhanced Operator/Maintainer*1997-2003	Moderate	2,731	0.58%	2,187	0.55%	543	0.73%
74C Telecommunications Operator-Maintainer*1995-2003	Moderate	2,657	0.56%	1,740	0.43%	915	1.26%
91K Medical laboratory Specialist	Moderate	2,597	0.42%	1,572	0.29%	1,025	1.30%
35E Radio and Communications Security Repairer*1995-2003	Moderate	2,062	0.43%	1,830	0.46%	232	0.31%
88N Transportation Management Coordinator*1987-2003	Moderate	1,958	0.35%	1,300	0.27%	658	0.85%
31S Satellite Communications Systems Operator-Maintainer	Moderate	1,617	0.29%	1,503	0.31%	114	0.15%
31P Microwave Systems Operator-Maintainer*1986-2003	Moderate	1,568	0.29%	1,404	0.30%	164	0.22%
67R AH-64 Attach Helicopter Repairer*1985-2003	Moderate	1,630	0.30%	1,537	0.33%	8493	0.12%

Light/Medium Demands Jobs							
71L Administrative Specialist	Light	20,610	3.07%	11,934	1.99%	8,662	10.86%
96B Intelligence Analyst	Light	3,658	0.61%	2,968	0.57%	689	0.88%
73C Finance Specialist	Light	3,639	0.55%	2,405	0.41%	1,232	1.55%
71D Legal Specialist	Light	2,118	0.34%	1,443	0.26%	675	0.86%
93P Aviation Operations Specialist*1984-2003	Light	2,059	0.36%	1,478	0.30%	580	0.75%
76J Medical Supply Specialist*1980-2002	Light	1,942	0.30%	1,277	0.23%	665	0.84%
91D Operating Room Specialist	Light	1,766	0.28%	1,189	0.21%	576	0.73%
71G Patient Administration Specialist	Light	1,570	0.24%	961	0.17%	609	0.77%
97B Counterintelligence Agent	Light	1,543	0.26%	1277	0.25%	265	0.34%
14E PATRIOT Fire Control Enhanced Operator Maintainer*1997-2003	Light	1,374	0.29%	1248	0.32%	126	0.17%
14R BRADLEY Linebacker Crewmember*1992-2003	Light	1,345	0.28%	1343	0.33%	2	0.00%
33W Electronic Warfare/Intercept Systems Repairer*1999-2003	Light	1,251	0.27%	1143	0.29%	108	0.14%
97E Human Intelligence Collector	Light	1,145	0.19%	849	0.16%	296	0.38%
96D Imagery Analyst	Light	926	0.15%	701	0.13%	225	0.29%
91S Preventive Medicine Specialist	Light	842	0.14%	547	0.10%	295	0.37%

* Indicates the years this specific code was used, if not used for entire study period.

SOW TASK 4. ICD-9-CM/VASRD CODE CROSSWALK CONSTRUCTION

We have completed a crosswalk between the Veteran's Administration Schedule for Rating Disabilities (VASRD) codes and International Classification of Disease, 9th Revision, Clinical Modification (ICD-9-CM) clinical diagnoses used in hospitalizations. Despite the huge increases in disabilities and the costs associated with them, relatively little is understood regarding their etiology and natural history. In part this may be due to the fact that the system for coding and describing disability is not clearly linked to the medical care system and clinical diagnoses. The Army VASRD system for categorizing and coding permanent disability is focused on describing functional impairment due to a disease or injury. VASRD codes are thus not actual clinical diagnoses. While it is likely that certain patterns of VASRD codes will link directly to certain clinical diagnoses, it is not clear how directly comparable these codes are to the ICD-9-CM codes that are used to describe conditions resulting in hospitalizations or outpatient visits. It is also not clear how the VASRD codes will relate to clinical diagnoses and treatment in hospitalizations and outpatient clinics for injuries and diseases occurring prior to, but possibly related to, the disability discharge. Understanding the link between clinical diagnoses and functional impairment codes is essential to identifying risk factors for disability and documenting the natural history of disabling conditions.

The purpose of this ICD-9-CM/VASRD Code crosswalk is to illuminate and document the association between common VASRD codes and ICD-9-CM clinical diagnoses. We address this aim in three ways: First, we explore commonly assigned ICD-9-CM codes for each broad VASRD group. Then, after identifying patterns of VASRD coding we located the most frequently used VASRD codes. These are then matched to any hospitalization record associated with an evaluation for disability (occurs in approximately 25%-30% of the cases) and we document the patterns (frequency distribution) of ICD-9-CM primary diagnoses associated with these top VASRD codes. Finally, in order to address possible temporal changes in coding, we explore the frequency of top VASRD and top ICD-9-CM coding over time. We are nearing completion on a draft of a technical report detailing the creation and results of this crosswalk between VASRD codes and ICD-9-CM diagnoses. Findings from completed analyses are reported below.

Initial analyses focus on broad VASRD groups. Tables 5a-5o (below) display the most common ICD-9-CM diagnostic categories associated with each major VASRD group among soldiers with a permanent disability who had a disability-related hospital record prior to their discharge from the hospital with a permanent disability.

TABLE 5a.– The 10 most common ICD-9-CM primary diagnoses associated with Musculoskeletal Conditions VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
719.4 Pain in Joint	4,749	15.79%
724.2 Lumbago	3,693	12.28%
718.8 Joint Derangement, Not Elsewhere Classified	1,453	4.83%
717.7 Chondromalacia Patellae	1,006	3.34%
715.9 Osteoarthrosis, Unspecified	962	3.20%
729.5 Pain in Limb	872	2.90%
716.1 Traumatic Arthropathy	855	2.84%
717.8 Other Internal Derangement of Knee	806	2.68%
722.1 Displacement of Thoracic or Lumbar Intervertebral Disc w/o Myelopathy	763	2.54%
733.1 Pathological Fracture	659	2.19%

* Percents are given out of the total number of Musculoskeletal disability cases with a disability-related hospital record, either CRO or TDRL (N=30,075).

TABLE 5b.– The 10 most common ICD-9-CM primary diagnoses associated with Mental Health Disorder VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
295.3 Paranoid Schizophrenia	506	13.13%
295.6 Residual Schizophrenia	362	9.39%
296.2 Major Depressive Disorder Single Episode	317	8.22%
296.3 Major Depressive Disorder, Recurrent Episode	237	6.15%
296.4 Bipolar Affective Disorder, Manic	186	4.82%
309.8 Other Specified Adjustment Reactions	184	4.77%
295.7 Schizoaffective Type	146	3.79%
295.9 Unspecified Schizophrenia	139	3.61%
296.7 Bipolar Affective Disorder, Unspecified	131	3.40%
296.6 Bipolar Affective Disorder, Mixed	105	2.72%

* Percents are given out of the total number of Mental Health disability cases with a disability-related hospital record, either CRO or TDRL (N=3,855).

TABLE 5c.– The 10 most common ICD-9-CM primary diagnoses associated with Neurological Disorders VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
345.9 Epilepsy, Unspecified	229	5.90%
346.9 Migraine, Unspecified	214	5.51%
340 Multiple Sclerosis	206	5.31%
780.3 Convulsions	150	3.86%
345.1 Generalized Convulsive Epilepsy	138	3.56%
784.0 Headache	101	2.60%
310.2 Postconcussion Syndrome	93	2.40%
608.9 Unspecified Disorder of Male Genital Organs	89	2.29%
354.2 Lesion of Ulnar Nerve	85	2.19%
355.3 Lesion of Lateral Popliteal Nerve	79	2.04%

* Percents are given out of the total number of Neurological disability cases with a disability-related hospital record, either CRO or TDRL (N=3,881).

TABLE 5d.– The 10 most common ICD-9-CM primary diagnoses associated with Respiratory System VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
493.9 Asthma, Unspecified	1,114	54.26%
493.0 Extrinsic Asthma	177	8.62%
135 Sarcoidosis	182	8.86%
496.0 Chronic Airway Obstruction, NEC	61	2.97%
518.8 Other Diseases of Lung	40	1.95%
519.1 Other Diseases of the Trachea and Bronchus. NEC	34	1.66%
493.1 Intrinsic Asthma	26	1.27%
780.5 Sleep Disturbances	21	1.02%
786.5 Chest Pain	21	1.02%
515 Postinflammatory Pulmonary Fibrosis	21	1.02%

* Percents are given out of the total number of Respiratory disability cases with a disability-related hospital record, either CRO or TDRL (N=2,052).

TABLE 5e.– The 10 most common ICD-9-CM primary diagnoses associated with Cardiovascular Conditions VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
414.0 Coronary Atherosclerosis	493	23.74%
733.1 Pathological Fracture	160	7.70%
443.0 Raynaud's Syndrome	93	4.48%
729.5 Pain in Limb	88	4.24%
733.9 Other and Unspecified Disorders of Bone and Cartilage	77	3.71%
414.9 Chronic Ischemic Heart Disease, Unspecified	67	3.23%
425.4 Other Primary Cardiomyopathies	67	3.23%
453.8 Venous Embolism and Thrombosis of Other Specified Veins	46	2.21%
429.2 Cardiovascular Disease, Unspecified	43	2.07%
401.9 Essential Hypertension, Unspecified	37	1.78%

* Percents are given out of the total number of Cardiovacular disability cases with a disability-related hospital record, either CRO or TDRL (N=2,077).

TABLE 5f.– The 10 most common ICD-9-CM primary diagnoses associated with Digestive System VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
555.9 Regional Enteritis, Unspecified Site	145	15.07%
556 Ulcerative colitis	60	6.24%
571.4 Chronic Hepatitis	57	5.93%
555.0 Regional Enteritis, Small Intestine	45	4.68%
556.0 Ulcerative (chronic) Enterocolitis	42	4.37%
789.0 Abdominal Pain	32	3.33%
564.1 Irritable Bowel Syndrome	31	3.22%
556.9 Ulcerative Colitis, Unspecified	29	3.01%
625.9 Unspecified Symptom associated with Female Genital Organs	28	2.91%
070.5 Other Specified Viral Hepatitis w/o mention of Hepatic Coma	27	2.81%

* Percents are given out of the total number of Digestive disability cases with a disability-related hospital record, either CRO or TDRL (N=962).

TABLE 5g.– The 10 most common ICD-9-CM primary diagnoses associated with Endocrine System VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total
250.0 Diabetes Mellitus w/o Mention of Complication	463	58.24%
250.9 Diabetes with Unspecified Complication	112	14.09%
250.1 Diabetes with Ketoacidosis	27	3.40%
250.5 Diabetes with Ophthalmic Manifestations	24	3.02%
250.6 Diabetes with Neurological Manifestations	20	2.52%
250.8 Diabetes with Other Specified Manifestations	16	2.01%
255.4 Corticoadrenal Insufficiency	10	1.26%
250.7 Diabetes with Peripheral Circulatory Disorders	9	1.13%
250.4 Diabetes with Renal Manifestations	6	0.75%
253.5 Diabetes Insipidus	6	0.75%

* Percents are given out of the total number of Endocrine disability cases with a disability-related hospital record, either CRO or TDRL (N=795).

TABLE 5h.– The 10 most common ICD-9-CM primary diagnoses associated with Infectious Disease, Immune Disorders, Nutritional Disease VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
042 Human Immunodeficienvy Virus	195	32.13%
710.0 Systemic Lupus Erythematosus	97	15.98%
135 Sarcoidosis	50	8.24%
112.0 Candidiasis of Mouth	20	3.29%
785.6 Enlargement of Lymph Nodes	19	3.13%
V67.5 Treatment Follow-up NEC	19	3.13%
710.1 Systemic Sclerosis	14	2.31%
729.1 Myalgia and Myositis, Unspecified	13	2.14%
780.7 Malaise and Fatigue	13	2.14%
695.4 Lupus Erythematosus	8	1.32%

* Percents are given out of the total number of Infectious Disease, Immune Disorders, Nutritional Disease disability cases with a disability-related hospital record, either CRO or TDRL (N=607).

TABLE 5i.– The 10 most common ICD-9-CM primary diagnoses associated with Disease of the Eye VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
362.7 Hereditary Retinal Dystrophies	37	6.51%
360.8 Other Disorders of the Globe	30	5.28%
368.2 Diplopia	29	5.11%
369.6 Profound Impairment, One Eye	25	4.40%
379.3 Aphakia and Other Disorders of Lens	24	4.23%
365.1 Open-angle Glaucoma	19	3.35%
377.3 Optic Neuritis	19	3.35%
369.7 Moderate or Severe Impairment, One Eye	18	3.17%
368.4 Visual Field Defects	17	2.99%
361.0 Retinal Detachment with Retinal Defect	16	2.82%

* Percents are given out of the total number of Eye disability cases with a disability-related hospital record, either CRO or TDRL (N=568).

TABLE 5j.– The 10 most common ICD-9-CM primary diagnoses associated with Skin Disorders VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
709.2 Scar Conditions and Fibrosis of Skin	65	13.46%
691.8 Other Atopic Dermatitis and Related Conditions	37	7.66%
692.9 Contact Dermatitis and Other Eczema, Unspecified	31	6.42%
696.1 Other Psoriasis	21	4.35%
705.8 Other Specified Disorders of Sweat Glands	20	4.14%
757.3 Other Specified Anomalies of Skin	14	2.90%
701.1 Keratoderma, Acquired	11	2.28%
701.4 Keloid Scar	11	2.28%
704.8 Other Specified Diseases of Hair and Hair Follicles	11	2.28%
692.4 Dermatitis due to Other Chemical Products	10	2.07%

* Percents are given out of the total number of Skin disability cases with a disability-related hospital record, either CRO or TDRL (N=483).

TABLE 5k.– The 10 most common ICD-9-CM primary diagnoses associated with Genitourinary Disorder VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
403.9 Hypertensive Renal Disease, Unspecified	33	8.05%
583.9 Nephritis and nephropathy, with Unspecified Pathological Lesion in Kidney	32	7.80%
582.1 Chronic Glomerulonephritis, with Lesion of Membranous Glomerulonephritis	23	5.61%
581.1 Nephrotic syndrome, with Lesion of Membranous Glomerulonephriti	22	5.37%
582.9 Chronic Glomerulonephritis with Unspecified Pathological Lesion in Kidney	19	4.63%
608.9 Unspecified Disorder of Male Genital Organs	17	4.15%
753.1 Cystic Kidney Disease	17	4.15%
581.9 Nephrotic Syndrome with Unspecified Pathological Lesion in Kidney	11	2.68%
583.8 Nephritis and nephropathy, with Other Specified Pathological Lesion in Kidney	11	2.68%
604.9 Other Orchitis, Epididymitis, and Epididymo-Orchitis, w/o Mention of Abscess	11	2.68%

* Percents are given out of the total number of Genitourinary disability cases with a disability-related hospital record, either CRO or TDRL (N=410).

TABLE 5l.– The 10 most common ICD-9-CM primary diagnoses associated with Diseases of the Ear and other sensory organs VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
389.1 Sensorineural Hearing Loss	122	39.95%
386.0 Meniere's Disease	40	12.90%
389.9 Unspecified Hearing Loss	22	7.10%
389.8 Other Specified Forms of Hearing Loss	20	6.45%
386.1 Other and Unspecified Peripheral Vertigo	14	4.52%
389.2 Mixed Conductive and Sensorineural Hearing Loss	12	3.87%
780.4 Dizziness and Giddiness	12	3.87%
386.5 Labyrinthine Dysfunction	8	2.58%
388.3 Tinnittus	7	2.26%
388.1 Noise Effects on Inner Ear	4	1.29%

* Percents are given out of the total number of Ear and Sensory Organ disability cases with a disability-related hospital record, either CRO or TDRL (N=310).

TABLE 5m.– The 10 most common ICD-9-CM primary diagnoses associated with Diseases of the Hemic and Lymphatic System VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
202.8 Other Lymphomas	15	7.11%
282.6 Sickle-Cell Anemia	15	7.11%
205.1 Chronic Myeloid Leukemia	13	6.16%
201.5 Hodgkins Disease, Nodular Sclerosis	12	5.69%
201.9 Hodgkins Disease, Unspecified	12	5.69%
200.1 Lymphosarcoma	7	3.32%
204.0 Acute Lymphoid Leukemia	7	3.32%
202.0 Nodular Lymphoma	6	2.84%
205.0 Acute Myeloid Leukemia	6	2.84%
238.4 Polycythemia Vera	6	2.84%

* Percents are given out of the total number of Hemic and Lymphatic disability cases with a disability-related hospital record, either CRO or TDRL (N=211).

TABLE 5n.– The 10 most common ICD-9-CM primary diagnoses associated with Gynecological Disorders VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
625.9 Unspecified Symptom Associated with Female Genital Organs	10	20.00%
617.9 Endometriosos, Site Unspecified	8	16.00%
174.9 Malignant Neoplasm of Breast, Unspecified	6	12.00%
789.0 Abdominal Pain	4	8.00%
614.6 Pelvic Peritoneal Adhesions, Female	3	6.00%
611.7 Signs and Symptoms in Breast	2	4.00%
614.9 Unspecified Inflammatory Disease of Female Pelvic Organs and Tissues	2	4.00%
174.8 Malignant Neoplasm, Other Specified Sites of Female Breast	1	2.00%
183.0 Malignant Neoplasm, Ovary	1	2.00%
198.8 Secondary Malignant Neoplasm, Other Specified Sites	1	2.00%

* Percents are given out of the total number of Gynecological disability cases with a disability-related hospital record, either CRO or TDRL (N= 50).

TABLE 5o.– The 10 most common ICD-9-CM primary diagnoses associated with Dental and Oral Conditions VASRD Group, 1981-2005.

ICD-9-CM code (number and title)	Frequency	Percent of total*
524.6 Temporomandibular Joint Disorder	12	60.00%
715.9 Osteoarthrosis, Unspecified	2	10.00%
141.0 Malignant Neoplasm, Base of Tongue	1	5.00%
524.3 Anomalies of Tooth Position	1	5.00%
526.8 Other Specified Diseases of the Jaw	1	5.00%
718.3 Recurrent Dislocation of Joint	1	5.00%
728.9 Unspecified Disorder of Muscle, Ligament, and Fascia	1	5.00%
991.2 Frostbite Of Foot	1	5.00%
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* Percents are given out of the total number of Dental and Oral disability cases with a disability-related hospital record, either CRO or TDRL (N=20).

The majority of disability and the category increasing most rapidly over the study period are those in the musculoskeletal disability group. This major category is further grouped in a number of ways. In order to better characterize these subgroups and their clinical significance we identified the most common specific subgroups of the VASRD musculoskeletal conditions. Figures 3-8 below display these subgroups, their size and the availability of hospital data to link clinical findings to VASRD codes.

Figure 3. Musculoskeletal VASRD cases versus all other VASRD cases and available disability-related hospital records, 1981-2005.

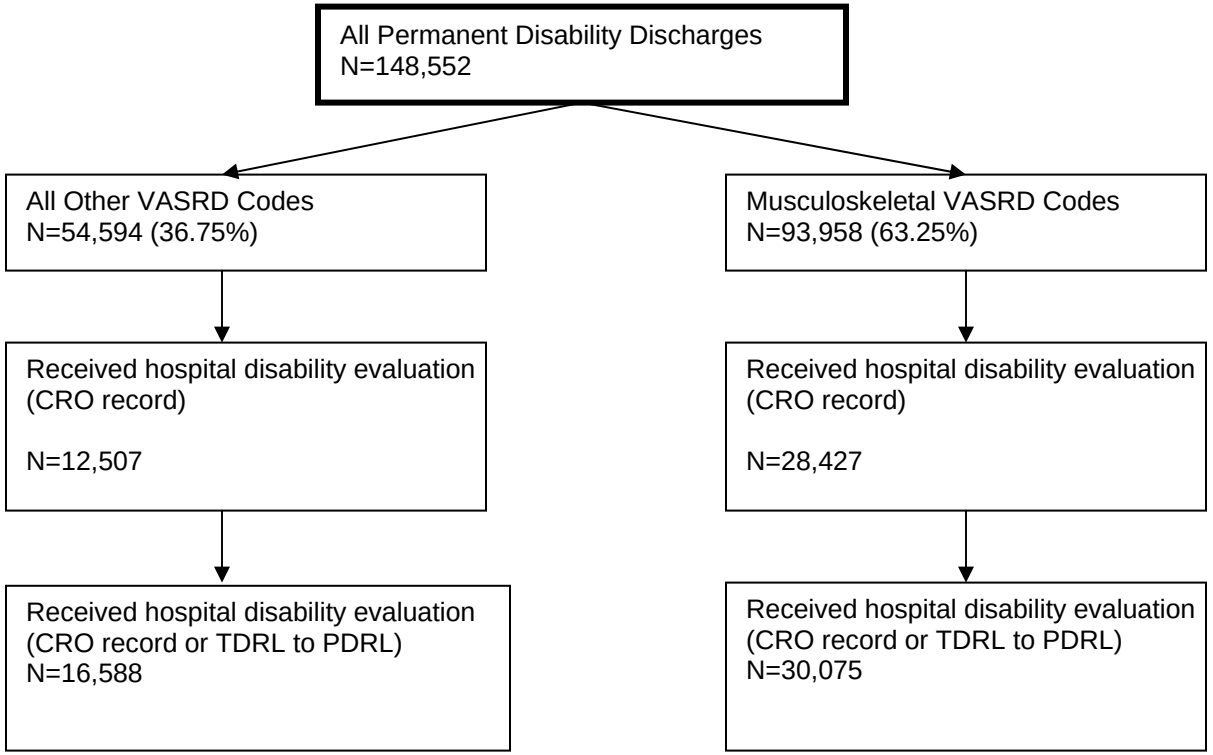


Figure 4. Categories of Musculoskeletal VASRD and available disability-related hospital records, 1981-2005.

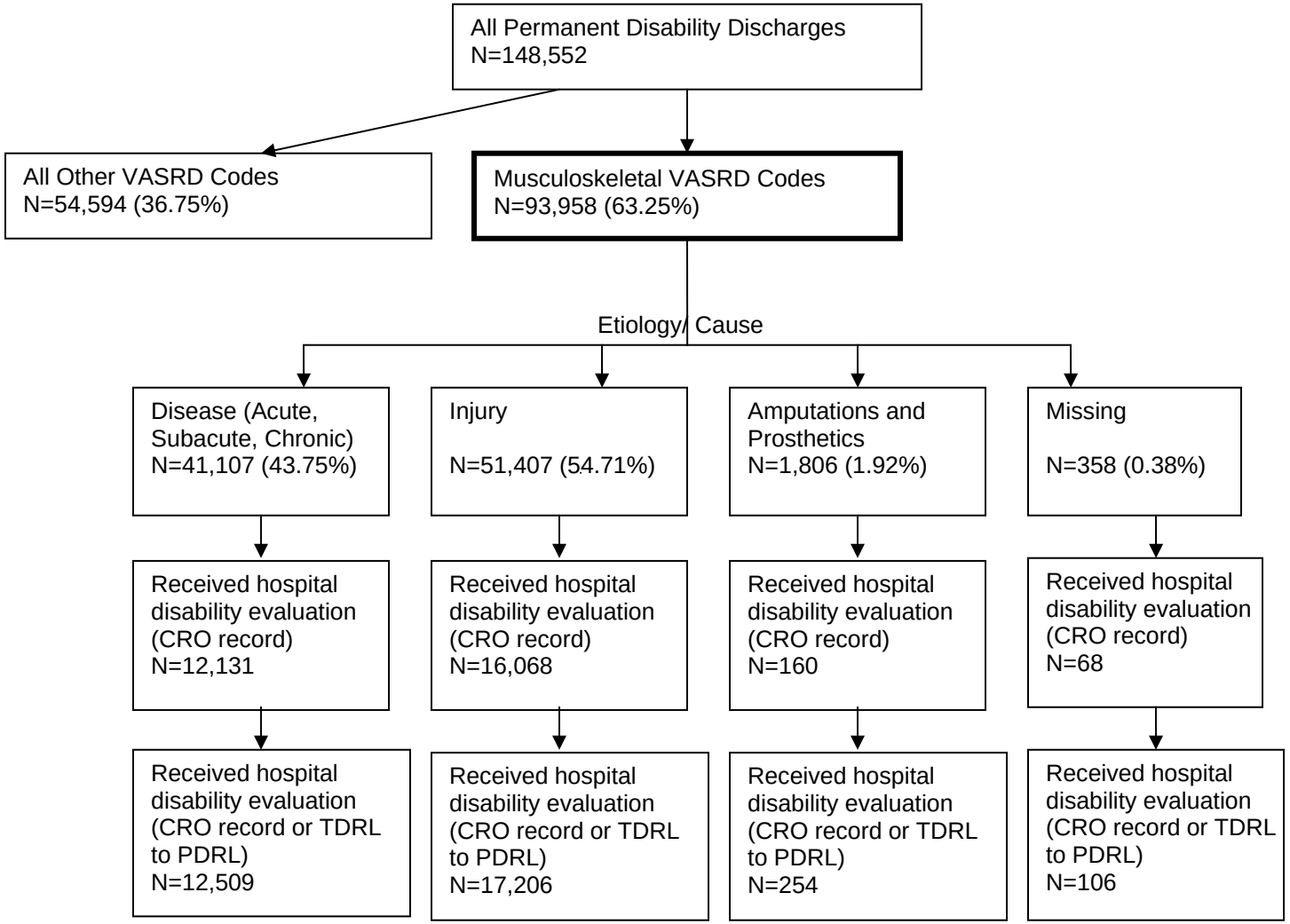


Figure 5. Subcategories of Musculoskeletal Disease VASRD cases and available disability-related hospital records, 1981-2005.

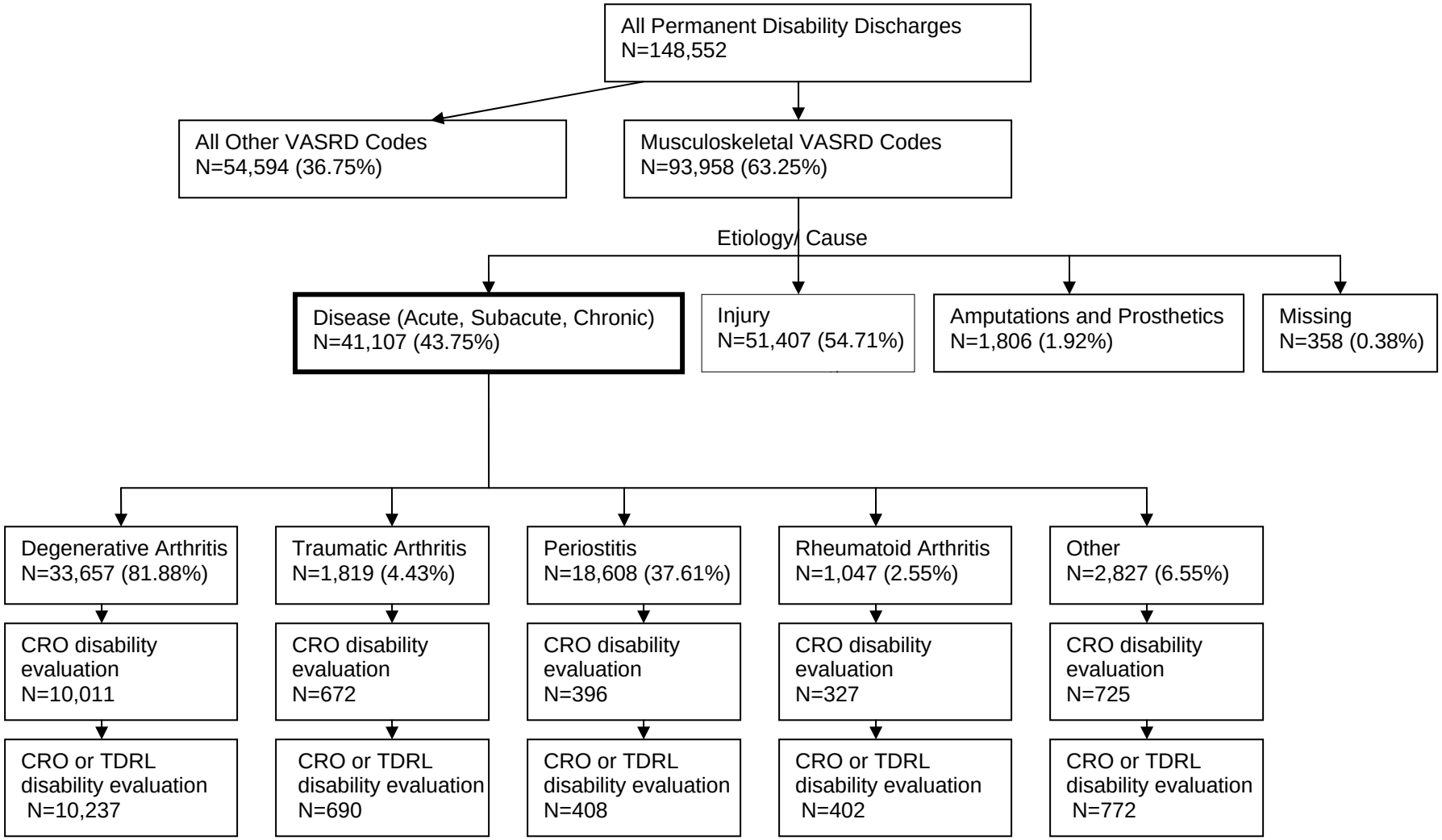


Figure 6. Categories of Musculoskeletal Injury VASRD cases, Muscle versus Skeletal and available disability-related hospital records, 1981-2005.

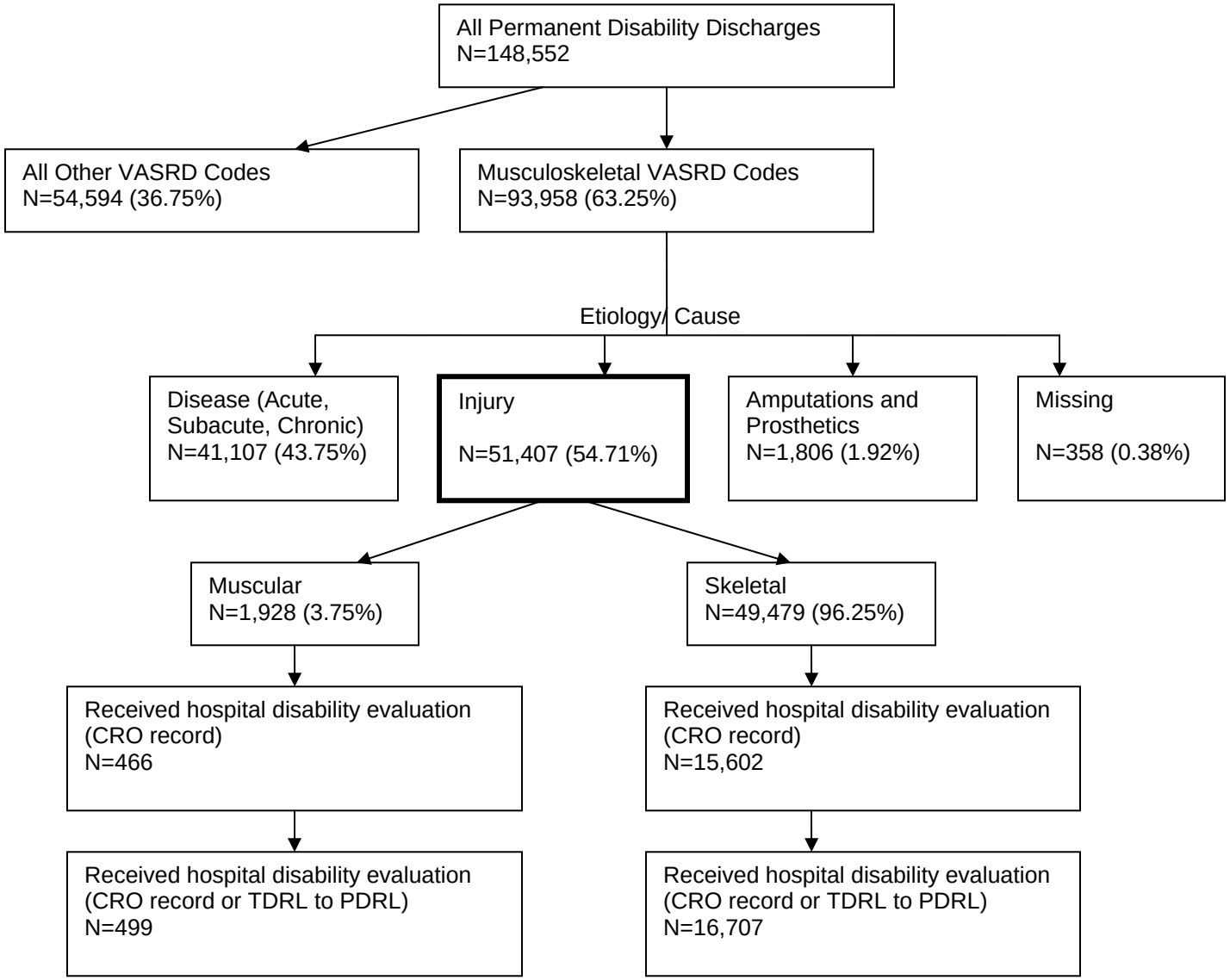


Figure 7. Subcategories of Musculoskeletal Muscle VASRD cases and available disability-related hospital records, 1981-2005.

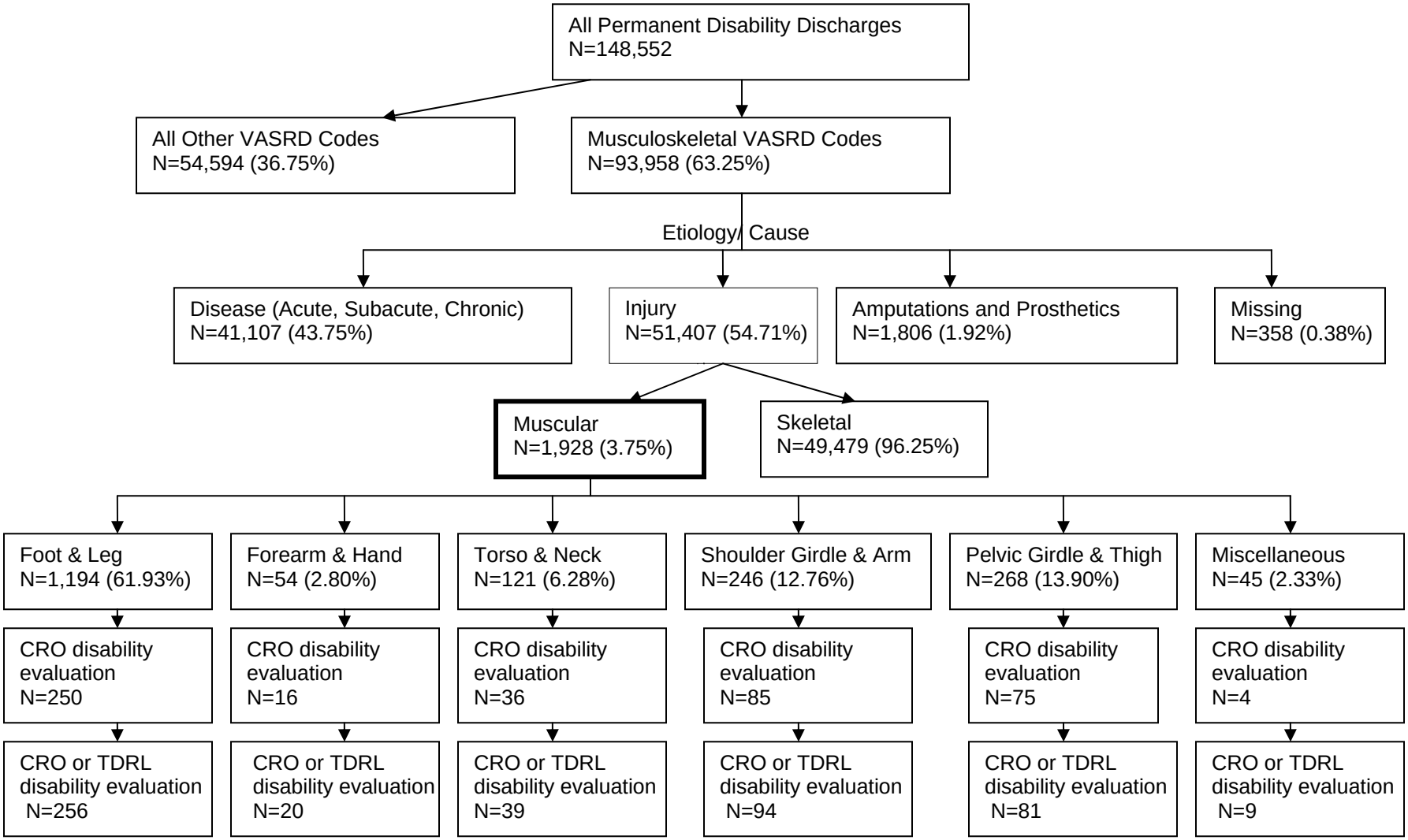
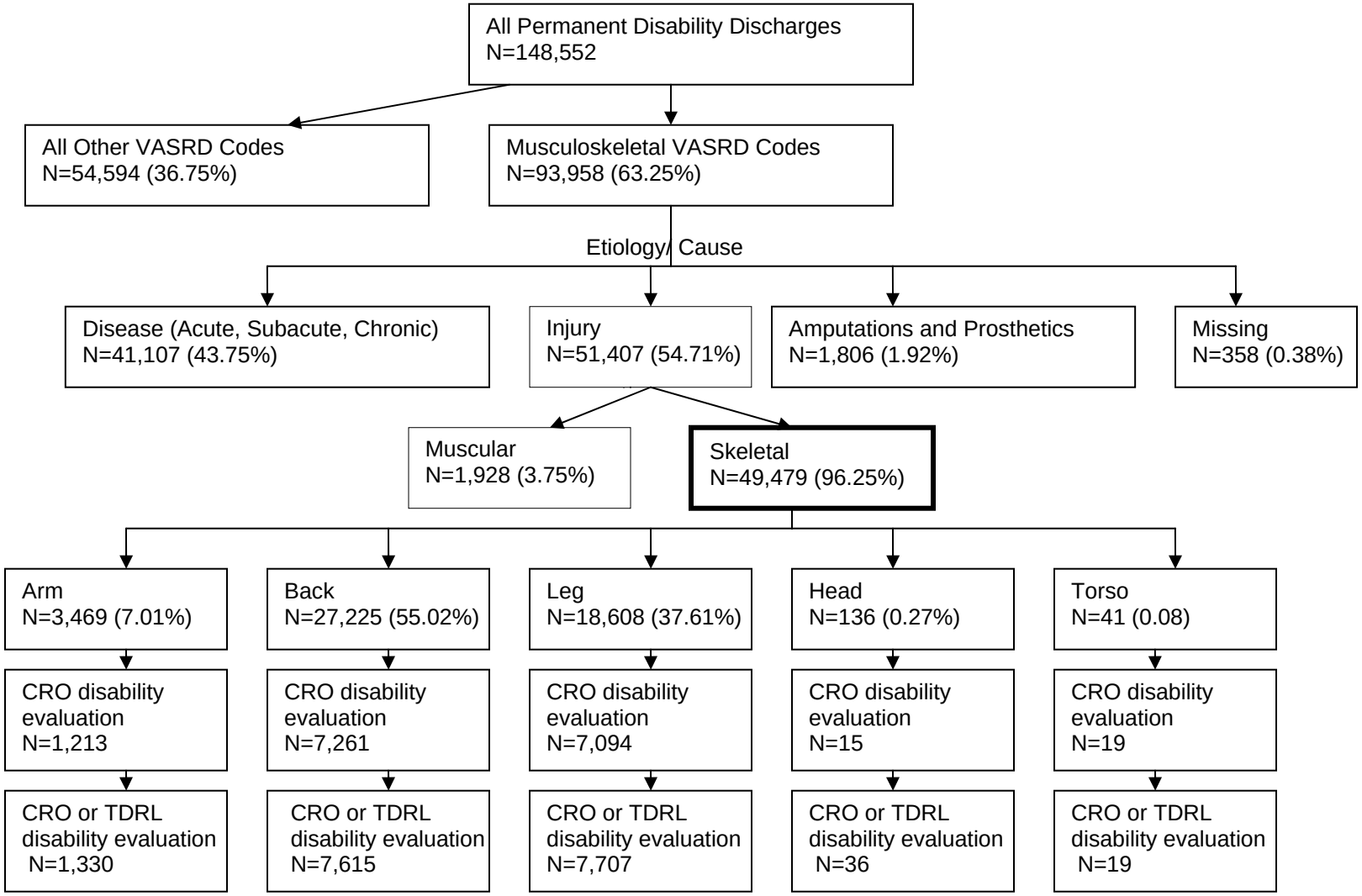


Figure 8. Subcategories of Musculoskeletal Skeletal VASRD cases and available disability-related hospital records, 1981-2005.



Tables 6-9 below detail findings after linking to hospitalization files. The most frequent ICD-9-CM diagnoses associated with a musculoskeletal condition subgrouped as “Disease” include: joint pain (26.6%), chondromalacia of patella (6.4%), and osteoarthrosis (5.3%). The most frequent ICD-9-CM diagnoses associated with a musculoskeletal condition subgrouped as “Injury” include: lumbago (19.7%), joint pain (8.1%) and joint derangement (6.9%). Nearly half of both musculoskeletal injury and musculoskeletal disease common diagnoses comprised lumbago, pain in joint, pain in limb, osteoarthrosis, other joint disorders and knee-related conditions (total = 42.5% for injuries and 47.4% for disease). For diagnoses where body part is specified, 25.8% of hospitalizations for those who ultimately received a musculoskeletal injury disability discharge, were for back disorders and 4% were for knee. For musculoskeletal disease disabilities, 2.4% of disability-related hospital diagnoses were for back-related disorders while 6.4% were for knee (Table 6).

Table 6. 10 most common ICD diagnoses within each subgroup of Musculoskeletal VASRD Conditions VASRD.

Categories of Musculoskeletal Conditions (N=93,958)	10 Most Common ICD Diagnoses	Frequency and Percent
Injury (N=51,407; 17,206 with disability-related hospital record)	724.2 Lumbago	3,389 (19.70%)
	719.4 Pain in Joint	1,398 (8.13%)
	718.8 Joint Derangement, Not Elsewhere Classified	1,185 (6.89%)
	722.1 Displacement of Thoracic or Lumbar Intervertebral Disc w/o Myelopathy	740 (4.30%)
	717.8 Other Internal Derangement of Knee	689 (4.00%)
	734 Flat Foot	618 (3.59%)
	733.8 Malunion and Nonunion of Fracture	465 (2.70%)
	729.5 Pain in Limb	346 (2.01%)
	756.1 Anomalies of Spine	314 (1.82%)
	715.9 Osteoarthrosis, Unspecified	297 (1.73%)
Disease (N=41,107; 12,509 with disability-related hospital record)	719.4 Pain in Joint	3,327 (26.60%)
	717.7 Chondromalacia of Patella	804 (6.43%)
	715.9 Osteoarthrosis, Unspecified	658 (5.26%)
	716.1 Traumatic Artropathy	594 (4.75%)
	729.5 Pain in Limb	512 (4.09%)
	733.1 Pathological Fracture	428 (3.42%)
	715.3 Local Osteoarthritis, Unspecified	392 (3.13%)
	719.8 Other Specified Disorders of the Joint	326 (2.61%)
	724.2 Lumbago	299 (2.39%)
	733.9 Other and Unspecified Disorders of Bone and Cartilage	280 (2.24%)
Amputation/Prosthetics (N=1,086; 254 with	736.8 Acquired Deformities of Other Parts of Limbs	44 (17.32%)

disability-related hospital record)	736.2 Other Acquired Deformities of Finger	26 (10.24%)
	719.4 Pain in Joint	19 (7.48%)
	729.5 Pain in Limb	14 (5.51%)
	733.4 Aseptic Necrosis of Bone	10 (3.94%)
	715.9 Osteoarthrosis, Unspecified	7 (2.76%)
	733.8 Malunion and Nonunion of Fracture	7 (2.76%)
	736.0 Acquired Deformities of Forearm, Excluding Fingers	7 (2.76%)
	736.7 Other Acquired Deformities of Ankle and Foot	6 (2.36%)
	718.5 Ankylosis 0f Joint	5 (1.97%)
Missing/Unknown (N=358; 106 with disability-related hospital record)	344.0 Quadriplegia and Quadriparesis	18 (16.98%)
	344.1 Paraplegia	10 (9.43%)
	719.4 Pain 1n Joint	5 (4.72%)
	724.2 Lumbago	5 (4.72%)
	344.6 Cauda Equina Syndrome	4 (3.77%)
	717.7 Chondromalacia of Patella	4 (3.77%)
	310.2 Postconcussion Syndrome	3 (2.83%)
	718.8 Joint Derangement, Not Elsewhere Classified	3 (2.83%)
	736.8 Acquired Deformities of Other Parts of Limbs	3 (2.83%)
	342.1 Spastic Hemiplegia	2 (1.89%)

We identified the most common ICD diagnoses associated with soldiers who ultimately receive a Musculoskeletal Disease disability. The top 4 most common conditions within the disease group of musculoskeletal disability make up over 93% of all musculoskeletal disease disability: degenerative arthritis, traumatic arthritis, periostitis, and rheumatoid arthritis. We then looked at the most common ICD diagnoses found in disability-related hospitalizations for these 4 groups (Table 7). Distribution of diagnoses did not vary much between subgroups of musculoskeletal disease. Of those discharged with a Periostitis disability, only 5.6% of those with a disability-related hospitalization had an ICD diagnosis for periostitis.

Table 7. 10 most common ICD diagnoses within each subgroup of Disease (within the Musculoskeletal Conditions broad VASRD group)

Categories of Musculoskeletal "Disease" Conditions (N=41,107)	10 Most Common ICD Diagnoses	Frequency and Percent
Degenerative Arthritis (N=33657; 10237 with disability-related hospital record)	719.4 Pain in Joint	3,089 (30.15%)
	717.7 Chondromalacia of Patella	757 (7.39%)
	715.9 Osteoarthrosis, Unspecified	574 (5.61%)
	729.5 Pain In Limb	445 (4.35%)
	716.1 Traumatic Artropathy	384 (3.75%)
	715.3 Local Osteoarthritis, Unspecified	356 (3.48%)
	719.8 Other Specified Disorders of the Joint	317 (3.10%)
	724.2 Lumbago	274 (2.68%)
	733.1 Pathological Fracture	262 (2.56%)
	718.8 Joint Derangement, Not Elsewhere Classified	237 (2.32%)
Traumatic Arhtitis (N=1819; 690 with disability-related hospital record)	716.1 Traumatic Arthropathy	207 (30.00%)
	719.4 Pain in Joint	87 (12.61%)
	715.9 Osteoarthrosis, Unspecified	79 (11.45%)
	716.9 Arthropathy, Unspecified	36 (5.22%)
	717.7 Chondromalacia of Patella	34 (4.93%)
	715.3 Local Osteoarthritis, Unspecified	33 (4.78%)
	715.2 Osteoarthritis, Localized, Secondary	21 (3.04%)
	717.8 Other Internal Derangement of the Knee	16 (2.32%)
	718.8 Joint Derangement, Not Elsewhere Classified	11 (1.59%)
	719.5 Stiffness of Joint, Not Elsewhere Classified	11 (1.59%)
Periostitis (N=1757; 408 with disability-related hospital record)	733.1 Pathological Fracture	155 (37.99%)
	733.9 Other and Unspecified Disorders of Bone and Cartilage	79 (19.36%)
	729.5 Pain In Limb	45 (11.03%)
	719.4 Pain in Joint	34 (8.33%)
	733.3 Periostitis	23 (5.64%)
	736.8 Acquired Deformities of Other Parts of Limbs	7 (1.72%)
	844.9 Sprain or Strain, Unspecified site of knee and leg	6 (1.47%)
	734 Flat Foot	5 (1.23%)
	625.9 Unspecified Symptom associated with Female Genital Organs	4 (0.98%)
	719.9 Unspecified Disorder of Joint	4 (0.98%)

Rheumatoid Arthritis (N=1,047; 402 with disability related hospital record)	714.0 Rheumatoid Arthtritis	105 (26.12%)
	099.3 Reiter's Disease	83 (20.65%)
	720.0 Ankylosing Spondylitis	51 (12.69%)
	719.4 Pain in Joint	15 (3.73%)
	712.9 Spondylosis of Unspecified Site	15 (3.73%)
	716.9 Arthropathy, Unspecified	11 (2.74%)
	274.0 Gouty Arthropathy	9 (2.24%)
	696.0 Psoriatic Arthropathy	9 (2.24%)
	714.3 Juvenile Chronic Polyarthritis	9 (2.24%)
	714.9 Unspecified Inflammatory Polyarthropathy	8 (1.99%)
Other (N=3874; 1174 with disability-related hospital record)	729.1 Myalgia and Myositis, Unspecified	117 (15.16%)
	719.4 Pain in Joint	105 (13.60%)
	726.7 Enthesopathy of Ankle and Tarsus	46 (6.35%)
	726.5 Enthesopathy of Hip	47 (6.09%)
	726.6 Enthesopathy of Knee	38 (4.92%)
	727.0 Synovitis and Tenosynovitis	22 (2.85%)
	730.1 Chronic Osteomyelitis	19 (2.46%)
	724.2 Lumbago	17 (2.20%)
	728.7 Other Fibromatoses	17 (2.20%)
	729.5 Pain In Limb	17 (2.20%)

When comparing the most common ICD diagnoses between soldiers who eventually receive a muscle-related injury musculoskeletal disability with those who receive a skeletal-related injury musculoskeletal disability, majority of diagnoses in the skeletal group (20.3%) received a diagnosis for lumbago while 23.5% of the muscular group were diagnosed with fibromatoses. Pain in joint, pain in limb and joint derangement were common among both groups. The muscular disability group had more muscle disorder-related hospitalizations while the skeletal group had more back- and knee-related hospitalizations.

Table 8. 10 most common ICD diagnoses within each subgroup of Injury (within the Musculoskeletal Conditions broad VASRD group)

Categories of Musculoskeletal Injury Conditions (N=51,407; 72,206 with a disability-related hospital record)	10 Most Common ICD Diagnoses	Frequency and Percent
Skeletal (N=49,479; 16,707 with disability-related hospital record)	724.2 Lumbago	3,387 (20.27%)
	719.4 Pain in Joint	1,363 (8.16%)
	718.8 Joint Derangement, Not Elsewhere Classified	1,177 (7.04%)
	722.1 Displacement of Thoracic or Lumbar Intervertebral Disc w/o Myelopathy	740 (4.43%)
	717.8 Other Internal Derangement of the Knee	688 (4.12%)
	734 Flat Foot	607 (3.64%)
	733.8 Malunion and Nonunion of Fracture	462 (2.77%)
	729.5 Pain In Limb	315 (1.89%)
	756.1 Anomalies of Spine	314 (1.88%)
	715.9 Osteoarthrosis, Unspecified	296 (1.77%)
Muscular (N=1,928; 499 with disability-related hospital record)	728.7 Other Fibromatoses	117 (23.45%)
	719.4 Pain in Joint	35 (7.01%)
	728.8 Other Disorders of Muscle, Ligament, and Fascia	35 (7.01%)
	729.5 Pain in Limb	31 (6.21%)
	729.1 Myalgia and Myositis, Unspecified	20 (4.01%)
	728.9 Unspecified Disorder of Muscle, Ligament, and Fascia	18 (3.61%)
	726.7 Enthesopathy of Ankle and Tarsus	11 (2.20%)
	734 Flat Foot	11 (2.20%)
	789.0 Abdominal Pain	11 (2.20%)
	718.8 Joint Derangement, Not Elsewhere Classified	8 (1.60%)

Since majority of musculoskeletal injury cases were of skeletal nature, we further explored the subcategories of back, leg, arm, head and torso. Back disabilities comprised 55% of all skeletal disabilities and the majority of diagnoses in disability-related hospital records were for back problems. Leg disabilities were the next largest subgroup of skeletal disability comprising 37.6%. Approximately 15% of soldiers with leg-related and a disability-related hospital record had a leg-related diagnosis but the rest, were unspecified conditions.

Table 9. 10 most common ICD diagnoses within each subgroup of Skeletal Injury (within the Musculoskeletal Conditions broad VASRD group).

Categories of Skeletal Musculoskeletal Injury Conditions (N=49,479; 16,707 with disability-related hospital record)	10 Most Common ICD Diagnoses	Frequency and Percent
Back (N=27,225; 7,615 with disability-related hospital record)	724.2 Lumbago	3,355 (44.06%)
	722.1 Displacement of Thoracic or Lumbar Intervertebral Disc w/o Myelopathy	737 (9.68%)
	756.1 Anomalies of Spine	312 (4.10%)
	722.5 Degeneration of Thoracic or Lumbar Intervertebral Disc	293 (3.85%)
	738.4 Acquired Spondylolisthesis	265 (3.48%)
	724.5 Backache, Unspecified	191 (2.51%)
	7244 Thoracic or Lumbosacral Neuritis or Radiculitis, Unspecified	185 (2.43%)
	724.6 Disorders of Sacrum	179 (2.35%)
	722.2 Displacement of Intervertebral Disc, Site Unspecified, w/o Myelopathy	156 (2.05%)
	721.3 Lumbosacral Spondylosis, w/o Myelopathy	108 (1.42%)
Leg (N=18,608; 7,707 with disability-related hospital record)	719.4 Pain in Joint	1,096 (14.22%)
	718.8 Joint Derangement, Not Elsewhere Classified	990 (12.85%)
	717.8 Other Internal Derangement of the Knee	685 (8.89%)
	734 Flat Foot	598 (7.76%)
	733.8 Malunion and Nonunion of Fracture	305 (3.96%)
	729.5 Pain in Limb	281 (3.65%)
	715.9 Osteoarthrosis, Unspecified	218 (2.83%)
	716.1 Traumatic Arthropathy	207 (2.69%)
	733.1 Pathological Fracture	198 (2.57%)
	717.7 Chondromalacia of Patella	195 (2.53%)
Arm (N=3,469; 1,330 with disability-related hospital record)	719.4 Pain in Joint	215 (16.17%)
	7183 Recurrent Dislocation	185 (13.91%)
	718.8 Joint Derangement, Not Elsewhere Classified	178 (13.38%)
	733.8 Malunion and Nonunion of Fracture	129 (9.70%)
	718.5 Ankylosis of Joint	90 (6.77%)
	719.5 Stiffness of Joint, Not Elsewhere Classified	83 (6.24%)
	726.2 Other Affections of Shoulder Region, Not Elsewhere Classified	45 (3.38%)
	716.1 Traumatic Arthropathy	42 (3.16%)

	715.9 Osteoarthrosis, Unspecified	29 (2.18%)
	716.9 Arthropathy, Unspecified	20 (1.50%)
Head (N=136; 36 with disability-related hospital record)	738.1 Other Acquired Deformity of the Head	16 (44.44%)
	724.2 Lumbago	3 (8.33%)
	345.9 Epilepsy, Unspecified	2 (5.56%)
	225.1 Benign Neoplasm, Cranial Nerves	1 (2.78%)
	310.2 Postconcussion Syndrome	1 (2.78%)
	342.9 Hemiplegia, Unspecified	1 (2.78%)
	352.9 Unspecified Disorder of Cranial Nerves	1 (2.78%)
	360.8 Other Disorders of Globe	1 (2.78%)
	361.8 Other Forms of Retinal Detachment	1 (2.78%)
	361.9 Unspecified Retinal Detachment	1 (2.78%)
Torso (N=41; 19 with disability-related hospital record)	733.6 Tietze's Disease	5 (26.32%)
	786.5 Chest Pain	3 (15.79%)
	730.9 Unspecified Infection of Bone	2 (10.53%)
	344.8 Other Specified Paralytic Syndromes	1 (5.26%)
	389.1 Sensorineural Hearing Loss	1 (5.26%)
	701.1 Keratoderma, Acquired	1 (5.26%)
	717.8 Other Internal Derangement of the Knee	1 (5.26%)
	719.4 Pain in Joint	1 (5.26%)
	719.8 Other Specified Disorders of the Joint	1 (5.26%)
	733.2 Cyst of Bone	1 (5.26%)

The distribution of ICD-9-CM diagnoses from disability-related hospitalizations has changed for all disability cases over time. Table 10 (below) shows the top 10 hospital diagnoses by era among soldiers with a permanent disability discharge for all broad VASRD groups combined. Asthma diagnoses rose over the time period, comprising 1.5% of cases from 1981-1989 to 12.3% of cases from 200-2005. Back- and knee-related disorders were consistently in the top ten diagnoses over time. Mental health disorders were in the top ten diagnoses for the first time period (1981-1989) and in the last period (2000+).

Table 10. Top 10 ICD-9-CM diagnoses by era—all VASRD groups.

Top 10 ICD-9-CM diagnoses					
1981-1989 N=15,805		**1990-1999 N-29,439**		**2000+ N=1419**	
ICD-9-CM	N (%)	ICD-9-CM	N (%)	ICD-9-CM	N (%)
724.2 Lumbago	781 (4.94%)	724.2 Lumbago	2,934 (9.97%)	493.90 Asthma, Unspecified w/o Status Asthmaticus or Acute Exacerbation	175 (12.33%)
719.46 Pain in Joint, Lower Leg	542 (3.43%)	719.46 Pain in Joint, Lower Leg	2271 (7.71%)	724.2 Lumbago	54 (3.81%)
718.86 JT Derangement NEC-L/Leg	536 (3.39%)	729.5 Pain in Limb	745 (2.53%)	309.81 Prolonged Posttraumatic Stress Disorder	40 (2.82%)
717.7 Chondromalacia Patellae	420 (2.66%)	493.90 Asthma, Unspecified w/o Status Asthmaticus or Acute Exacerbation	639 (2.17%)	729.1 Myalgia and Myositis, Unspecified	27 (1.90%)
414.0 Coronary Atherosclerosis	381 (2.41%)	719.47 Pain in Joint, Ankle and Foot	600 (2.04%)	135 Sarcoidosis	22 (1.55%)
295.3 Paranoid Schizophrenia	274 (1.73%)	717.7 Chondromalacia of Patella	590 (2.00%)	346.90 Migraine Unspecified, w/o intractable migraine	22 (1.55%)
295.6 Residual Schizophrenia	256 (1.62%)	722.10 Lumbar Intervertebral Disc w/o Myelopathy	513 (1.74%)	555.9 Regional Enteritis, Unspecified Site	22 (1.55%)
734 Flat Foot	250 (1.59%)	717.83 Old Disruption of Anterior Cruciate Ligament	446 (1.51%)	719.46 Pain in Joint, Lower Leg	20 (1.41%)
493.90 Asthma, Unspecified w/o Status Asthmaticus or Acute Exacerbation or	243 (1.54%)	718.86 Other Joint Derangement, Not Elsewhere Classified, Lower Leg	426 (1.45%)	296.20 Major Depressive Disorder, Single Episode, Unspecified	18 (1.27%)
717.83 Old Disruption of Anterior Cruciate Ligament	207 (1.31%)	734 Flat foot	415 (1.41%)	296.30 Major Depressive Disorder, Recurrent Episode, Unspecified	18 (1.27%)

Musculoskeletal conditions have been the most commonly assigned VASRD codes since 1981, but musculoskeletal VASRD codes have increased as a proportion of all VASRD conditions. Musculoskeletal VASRD codes comprised 51% of disability cases from 1981-1989, yet they comprised 67% of cases in the 1990s and were up to nearly 70% from 2000 to 2005. The most common ICD-9-CM diagnoses among soldiers who ultimately received a musculoskeletal disability also varied somewhat over time (Table 11), though pain in joint and lumbago were consistently the top two causes of musculoskeletal conditions throughout the time period.. Between 1981 and 1989 and from 1990 to 1999 join derangement, along with pain in joint and lumbago, were the top three most common ICD-9-CM diagnoses associated with musculoskeletal conditions. From 2000 to 2005 (the end of our study period) the most common ICD-9-CM diagnoses associated with musculoskeletal conditions were: lumbago, pain in joint and myalgia and myositis. It is not clear whether the changes in patterns of clinical diagnoses observed for more recent time periods reflect variations in risk for musculoskeletal diseases, or changes in diagnostic assessment and/or coding practices.

Table 11. Top 10 most common ICD diagnoses for Musculoskeletal Conditions by era

Era	ICD-9-CM Code (Number and Title)	Frequency and Percent
1981-1989	719.4 Pain in Joint	846 (9.41%)
	724.2 Lumbago	761 (8.46%)
	718.8 Joint Derangement, Not Elsewhere Classified	631 (7.02%)
	717.7 Chondromalacia Patellae	418 (4.65%)
	716.1 Traumatic Artropathy	370 (4.11%)
	733.8 Malunion and Nonunion of Fracture	309 (3.44%)
	717.8 Other Internal Derangement of the Knee	292 (3.25%)
	715.9 Osteoarthrosis, Unspecified	250 (2.78%)
	715.3 Local Osteoarthritis, Unspecified	249 (2.77%)
	722.1 Displacement of Thoracic or Lumbar Intervertebral Disc w/o Myelopathy	241 (2.68%)
1990-1999	719.4 Pain in Joint	3,866 (18.60%)
	724.2 Lumbago	2,890 (13.91%)
	718.8 Joint Derangement, Not Elsewhere Classified	809 (3.89%)
	715.9 Osteoarthrosis, Unspecified	705 (3.39%)
	729.5 Pain in Limb	676 (3.25%)
	717.7 Chondromalacia Patellae	585 (2.81%)
	733.1 Pathological Fracture	560 (2.69%)
	722.1 Displacement of Thoracic or Lumbar Intervertebral Disc w/o Myelopathy	514 (2.47%)
	717.8 Other Internal Derangement of the Knee	512 (2.46%)
	716.1 Traumatic Artropathy	482 (2.32%)
2000-2005	724.2 Lumbago	42 (14.00%)

	719.4 Pain in Joint	37 (12.33%)
	729.1 Myalgia and Myositis, Unspecified	27 (9.00%)
	718.8 Joint Derangement, Not Elsewhere Classified	13 (4.33%)
	722.1 Displacement of Thoracic or Lumbar Intervertebral Disc w/o Myelopathy	8 (2.67%)
	729.5 Pain in Limb	8 (2.67%)
	715.9 Osteoarthrosis, Unspecified	7 (2.33%)
	714.0 Rheumatoid Arhtitis	6 (2.00%)
	733.4 Aseptic Necrosis of Bone	6 (2.00%)
	715.3 Local Osteoarthritis, Unspecified	5 (1.67%)

SOW TASK 5. PAPER 1

We have completed a draft of our first paper "The changing profile of disability in the U.S. Army soldiers: 1981 – 2005." This paper describes temporal changes in disability, the demographic profile of those with a disability and temporal changes in the demographic profile of those discharged with a permanent disability from the Army. In particular, the paper addresses a fundamental question regarding the influence of changes in the underlying Army population demographic composition on the disability rate. Specifically, the army has become more female, the age composition and race/ethnicity composition have also changed with time such that the army is now older with a slightly lower percentage of African Americans but greater representation by Hispanics. The proportion of soldiers with a college degree has also increased slightly. Over the 25 year study period the army substantially decreased the size of the overall force from 922, 448 in 1981 to 564, 802 in 2005. During this same time period the numbers of disabilities each year increased from 1,641 in 1981 to 7,126 in 2005. The annual disability discharge rate per 100,000 population increased by over 600%. In 1981 the rate per 100,000 soldiers was 178/100,000 but by 2005 the rate had climbed to 1,262 per 100,000 soldiers.

The objective of paper 1 is to describe the population of soldiers who are leaving the army with a permanent disability, and to document changes in the risk profile over time. Because the underlying army population demographics have changed over the study period, a major objective of these analyses is to clarify how much of the overall increase in disability rates is simply explained by the overall changing army demographics. Selected highlights from paper 1 are presented below and a copy of the complete text (still in draft form) may be found in Appendix A.

Soldiers discharged with a permanent disability between 1981-2005 were more likely to be female, older than 21 and less than 40 (particularly age 31-35), married or previously married, mid-level or junior enlisted (as opposed to senior enlisted or officers) and they are significantly less likely to have a college education. As noted above, many of these demographic factors have shifted in the underlying army population over the study period (e.g., army is more female now). To assess the hypothesis that changes in

the army population explain increasing disability rates, the unadjusted disability rates per 100,000 population and disability rates per 100,000 adjusted for changes in gender, race, age and total time on active duty were plotted side by side. The adjustment does not explain the increasing risk of disability over the time period. In part the lack of effect with the standardization may be due to shifts in the relationship between certain demographic factors and risk of disability over time. In order to begin to understand the underlying etiology of the increasing disability rate, it is important to determine whether identified risk factors are constant OR, whether they, too, are changing. That is, is the overall face of disability changing in the Army?

A closer inspection of population-specific disability rates over the study period reveal shifts in the relationship between key demographic factors and risk for disability. For example, early in the study period disability risk was similar for men and women. But, by the end of the study period the rates for women were far out-pacing disability rates for men. Similarly, in the beginning of the study period, soldiers over age 40 were at greatest risk for permanent disability but by the middle of the study period their risk dropped, in comparison to other age groups, and became the lowest risk group where they have remained throughout the remainder of the study period. College education has become increasingly protective over the study period.

In addition to visual examination of rates for specific demographic sub-groups of the Army, we also explored temporal changes in the profile of those with disability using time series analytic models. The changing demographic profile of soldiers with disability in some cases mirrors the underlying changes in the total Army population, but in other cases is in direct contrast. The proportion of female and minority soldiers with a permanent disability increased at the same time as the relative numbers of women and minority soldiers (at least Hispanic soldiers) increased. There was a decline in the mean age and total time in service of soldiers discharged with a disability over the study. Thus even though the army at large is getting older and staying on active duty longer, the average age and tenure of those with a disability is getting younger and shorter, respectively. The results from the autoregressive time-series analysis models exploring temporal changes in the demographic profile of those with a disability-related discharge indicated that each of the time trend models for proportions of female and white soldiers, mean age and mean time in service are statistically significant. The positive association of the time trend for female gender indicates that the proportions of female soldiers increased by 10% with each increasing year (exponent [0.10*1.0] = .10). The positive association of the time trend for white race indicates that the proportions of white soldiers increased by 0.5% with each increasing year (exponent [0.005*1.0] = .05). Even though on average the Army got older during this study time period, the mean age as well as time in service of those discharged with a disability decreased over time. Mean age decreased by 0.38% and time in service decreased by 0.2% with each increasing year.

The changing profile of disability suggests that key demographic groups to focus on include women, younger soldiers (under age 40), junior or mid-level enlisted solders, and those with less than a college education. In addition to these demographic groups,

analyses of specific types of disabilities reveals the startling increase in disabilities due to musculoskeletal conditions (mostly injuries or late-effects of injury). While most of the disability categories/types remained stable or declined over the study period, musculoskeletal conditions increased at an alarming rate.

This, then, is our target for prevention. Future analyses will focus on clarifying the underlying etiology of this increase overall and within the identified high risk groups.

ADDITIONAL GRANT RELATED ACTIVITIES COMPLETED IN YEAR 1

We have made significant progress on the second paper promised under year 2 for this grant. This second paper focuses on VASRD codes and changes in these codes, as well as compensation, over time and by demographic groups. We are completing multinomial logistic regression models that will allow us to compare demographic risk factors for soldiers who experience permanent disability and receive different levels of compensation.

Findings from preliminary analyses for papers 1 and 2 were included in two abstracts submitted for review and accepted for oral presentation at the American Public Health Association's Annual meeting in Washington, DC, November 2007.

On July 20, 2006, we submitted a summary report of findings and efforts under this project as well as a request for Continuing Review for our study protocol with the USARIEM Human Use Review Committee (HURC). We received approval following their review on August 7, 2006. A copy of the Continuing Review is attached to this report in Appendix B.

KEY RESEARCH ACCOMPLISHMENTS

- Enumerated the burden of disability over the past 25 years (frequency and rates)
- Clarified population at risk – both overall and by era
- Identified high risk population whose increasing rates of disability should be the focus of targeted intervention efforts
- Rejected the hypothesis that the increasing disability trend is a function of changes in the underlying army population demographics
- Identified high priority disability general causes or types (muscloskeletal conditions)
- Identified temporal shifts in patterns of risk including age and gender interactions that will need to be considered in any future analytic models
- Linked VASRD Army disability codes to clinical diagnoses
- Identified most common clinical diagnoses, which should be incorporated into intervention planning efforts as well as program evaluation steps
- Developed framework for assessing occupational risk exposure by linking occupations to physical demands scales
- Crosswalked MOS (occupational) codes over the study period

REPORTABLE OUTCOMES

* Permanent disability rates per 100,000 army population have increased by over 400% over the past 25 years.

* Increasing disability rates are not explained by increases in the relative proportion of women, Hispanic, higher educated, and older soldiers nor the relatively greater representation of officers (versus enlisted) now in the Army.

* Disability rates are increasing more rapidly among younger soldiers (under age 40), junior and mid-level enlisted soldiers, women, and those with less than a college degree. Analyses are unadjusted and thus should be interpreted with caution. Future, multivariate models are indicated (and will be completed in future analyses).

* Increases in musculoskeletal-related disability are driving the overall increase in disability. Most other disability categories have remained stable or declined over the past 25 years.

CONCLUSIONS

Little research has been published describing the population of soldiers who leave the US Army with a permanent disability. Even less is known about the underlying causes of these disabilities. Yet, disability rates are increasing rapidly resulting in huge economic losses to the U.S. government and, ultimately, the tax payer. In addition, and more importantly, more than 5000 people are being discharged per year (in recent years) from the army with a life-altering disability. Changes in the underlying Army population demographics over time do not explain the overall increased risk in disability. While increases in disability risk are generally being experienced across all military demographic groups, the subgroups with the fastest growing rates are women, junior enlisted and younger soldiers. The primary cause of these disabilities appears to be injury or the adverse effects of acute and chronic injury and related conditions. More research is needed to understand the etiology of these conditions.

Future research should include multivariate predictive models to assess independent effects of gender, education, rank and age. These models should control for changing temporal patterns (interactions) (e.g., increasing risk among women over time, decreasing risk for older age, increasing protective effect of college education). Future analyses should also assess associations with particular types of disability and clarify patterns of risk for different types of disability within high-risk subgroups as well as risk factors for different types of disability. Models will need to control for variations in disability eligibility (e.g., time in service). Ultimately, results from this work and other needs to be used to inform interventions with well-conceived evaluation plans in order to assess effectiveness in reducing the burden of disability.

The dynamic use of MOS codes over time to describe enlisted occupations makes the study of any temporal patterns or risk factors for injury or disability within an occupational cohort difficult. The ability to crosswalk MOS codes over time is a great advantage for the study of any long-term health or behavioral trends among specific military occupations of interest. Moreover, identifying MOS codes according to level of physical demand required by these occupations can help determine differential risk factors for injury. Such information can be used to develop targeted interventions for specific occupations within the military. Likewise, the ability to link disability-related hospitalizations to VASRD codes assigned in a permanent disability discharge can inform research and to better understand the natural history of disability within the military.

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LIST OF APPENDICES

Appendix A – The changing profile of disability in the U.S. Army soldiers: 1981 - 2005 (Manuscript Draft).

Appendix B – Approved Continuing Review for USARIEM No. H00-10y “Risk Factors for Discharge from the Army with a Permanent Disability.” August 2006.

Appendix A

The changing profile of disability in the U.S. Army soldiers: 1981 - 2005

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Abstract

Objective:
Describe the demographic profile of US Army soldiers discharged with a permanent disability between 1981 and 2005 and clarify whether underlying Army demographic changes explain the substantially increasing disability rate.

Methods:
Demographic data were taken for all active-duty Army soldiers discharged with permanent disability between January 1981 and December 2005 (N=108,119). Frequencies, adjusted rates, univariate logistic regression models and time-series analyses describe and assess trends.

Results: The disability rate increased by over 600% to 1,262 per 100,000 soldiers by 2005. Unadjusted disability risk factors include female gender (OR=1.37; CI:1.35-1.39), midlevel enlisted rank versus junior enlisted (OR=1.55 CI:1.54-1.57), and married or formerly married (versus single). College degree or greater and age over 40 were protective. Though Army soldiers became more female, older, longer-tenured, better-educated, with more officers and relatively fewer enlisted over this time period, adjusting for underlying demographic changes did not explain the rapidly increasing disability rate. Time-series analyses revealed temporal changes in underlying risk for disability such that disability risk among women is increasing (independent of increasing women in the underlying population) as are risks for soldiers who are younger, lower-ranked and have shorter service tenure.

Conclusions:
Disability is an expensive and growing problem for the Army. Temporal changes in underlying Army population demographics do not explain the overall increased risk in disability. While disability increases occur across all demographic groups, fastest growing rates are among female, junior enlisted and younger soldiers. Primary cause of disability appears to be injury or adverse effects of acute and chronic injury. Research is needed determine underlying causes of these conditions and should to be used to inform interventions with well-conceived plans to evaluate their effectiveness in disability reduction.

Introduction

Disability is a large and growing problem in both military and civilian populations within the United States today. Among working-age civilians, the rate of persons receiving benefits for a permanent disability rose approximately 40% between 1990 and 1999 (18). The costs of occupational disability among civilian populations in the U.S. in 1997were estimated at approximately $182.6 billion. Moreover, per capita medical expenses for adults ages 18 or older were five times greater for those with a disability than for the non-disabled population (30). Public benefits for all disabled beneficiaries in the United States amounted to almost $76 billion in 2005 (2).

The economic costs of disability to the U.S. military and the Veteran's Administration are staggering. In Fiscal Year (FY) 2005, retired, disabled military service members were paid 1.25 billion, $474 million of which was for disabled Army retirees (13).. The Department of Veterans Affairs (VA) estimated disability payments of over $3.1 billion in 2005 (28). When VA disability benefits are offset by regular earned retirement pay, the total disability benefits disbursed by the military in 2002-2003 were approximately $18.5 billion (5). While the total medical care costs for disabled Army soldiers are unknown, VA facility treatment costs for those with a medical discharge between 1986 and 1995 were estimated at approximately $124 million in 2001 alone (5, 29). These costs are only part of the picture. Reductions in work productivity prior to disablement, wage losses of both the disabled individual and any caretakers, inability to perform household tasks, and decreased quality of life due to the disabling condition are not factored in to the costs of disability (17, 19). Recruitment and replacement training costs, as well as the costs due to the loss of experienced employees, are not estimated. Similarly, medical care for the condition prior to disablement and administrative costs associated with evaluating and processing the disability are unknown. Also unknown are the costs associated with the Army's investment in training and maintaining soldiers whose careers are cut short by a disability.

Between 1981 and 2002, the number of active duty Army personnel fell by 37% as part of an overall downsizing effort (12). This reduction in manpower implies that soldiers are becoming ever more important resources that may not be quickly or easily replaced in the event of a disability, affecting both the morale of the remaining troops and combat readiness (10). At the same time, the health-related quality of life of active duty soldiers, which includes perceptions of physical and mental health, stress, depression, anxiety and occupational stress, is lower than can be found in the civilian population (8, 11); these factors may increase the risk for poor health and subsequent disability. The retention of soldiers is crucial, yet reasons for separation are poorly understood, leading the U.S. General Accounting Office (GAO) to recommend that the military collect better data on this issue (27). The importance of such data for the prevention of disability in active duty soldiers is clear.

It is also important to tease out the effects of demographic shifts from real changes in disability. At the same time as the Army disability rates have increased, the

demographic profile of active duty soldiers has changed. From 1985 to 2005 the ratio of males to females has declined and the army as a whole is better educated as measured by the Armed Forces Qualification Test, though the actual educational credentials among enlisted recruits have not changed much since 1985 (21); the army was also older in 2005 than it was in 1985 (Source: DMDC personnel files, TAIHOD data, 1985-2005). Despite the large and growing problem of disability among military populations, relatively few studies have documented associations between demographic factors and disability in the military. Some studies have found that women are at greater risk for injuries, illnesses, and medical disability discharge than men (15, 16, 24, 25), although most of these studies have focused primarily on musculoskeletal disabilities, usually a particular type of musculoskeletal condition (e.g., knee injury). Estimates of the excess risk of discharge for injuries in females compared to males in the military range from 2.5:1 (24) to 7.0:1 (16). The reasons postulated for this finding include lower levels of physical fitness and endurance (24), differences in strength and ergonomic differences (16), and a greater likelihood of seeking medical care (23). Age has also has been associated with risk of occupational disability, but the relationship has not been consistent in studies of army populations and the few studies available focus only on musculoskeletal injury (14, 25). The relationship between age and occupational disability may not be linear and probably interacts with gender or other factors (25). Age may also be confounded by other factors such as rank and time in service, as older individuals are more likely to be in higher ranks and longer service and consequently less likely to be in highly physically demanding jobs that cannot be performed with physical limitations (20, 26).

In assessing the significance of the increasing trends in disability it is important to clarify what proportion of the increase in disability may be attributable to changes in the demographic characteristics of the army population at large and what proportion of the increased disability rate remains unexplained or requires greater investigation in order to uncover the etiology.

Aims

The objectives of this descriptive study are to (1) document and describe the population of soldiers discharged from the army with a permanent disability; (2) to clarify whether overall changes in the demographic composition of the Army population at large explain the temporal change in disability discharge rates occurring in the same time period; and (3) to describe the changing demographic profile of those who are disabled in order to better inform interventions and future analytic work.

Methods

Data Sources. Data come from the Total Army Injury and Health Outcomes Databases (TAIHOD), a compilation of files containing demographic and health information on active-duty Army personnel that can be linked through individual identifiers (6, 7, 9). This paper included TAIHOD data from personnel records (demographic and discharge

information) from the Defense Manpower Data Center (DMDC) and disability board records from the US Army Physical Disability Agency.

Sample. The total sample of all active-duty Army soldiers discharged with permanent disability between January 1981 and December 2005 included in this analysis is 108,119 soldiers.

Measures

Disability Outcome Measure

DoD Directive 1332.18 defines disability as "Separation from the Military Service by Reason of Physical Disability" (1996). The disability can be caused by, aggravated by, or even unrelated to military service. Title 10, U.S. Code, Chapter 61. DoD Directive 1332.18 outlines the requirements and procedures for separations due to a physical disability with the primary requirement being that the soldier must be unfit to carry out duties of his or her rank, office, or grade due to a physically disabling condition that substantially limits or precludes fulfillment of the purpose of their active-duty employment.

Soldiers whose physical or mental health conditions make them unlikely to return to active duty despite having received optimal medical treatment for their condition are referred to a Medical Evaluation Board (MEB). The MEB reviews all available medical and occupational evidence and makes a recommendation regarding the need for another disability evaluation, which is performed by the Physical Evaluation Board (PEB). Following PEB evaluation, if a determination of unfitness is made, the PEB further determines if the condition is stable (no further improvement expected). Stable conditions are eligible for a permanent disability discharge. When the PEB evaluation finds that there is some potential for improvement in the condition, the soldier may be recommended for the Temporary Disability Retired List after which he or she will be re-evaluated periodically over the ensuing 5 years to assess his or her ability to return to active duty. Only confirmed permanent disabilities with a record of discharge from the Army were used for analysis in this study.

Type of Disability

The Army uses the Veterans Administration Schedule for Rating Disabilities (VASRD) to describe and rate disabilities. Organized into 15 body/organ system groups, the VASRD describes functional limitations that can be used as the basis for a percentage of disability. Causes or major types of disability are defined in the VASRD. These are: Musculoskeletal system, Neurological conditions, Mental disorders, Cardiovascular system, Respiratory system, Endocrine, Digestive system, Disease of the eye, The skin, Genitourinary system, Infectious diseases, Immune Disorders, Nutritional disease, Hemic and Lymphatic system, Disease of the ear and other Sensory Organs, Gynecological, Dental and Oral conditions.

Demographic covariates

Demographic covariates included gender, age, race, marital status, education, and time in service. Most demographic variables come from the DMDC. Age is coded as less than 21 years, 21-25 years, 26-30 years, 31-35 years, 36-40 years and greater than 40 years; race is categorized as white, black, Hispanic and other; marital status includes single (never-married), married and previously married (i.e. widowed, divorced, or legally separated); education is coded as less than or equal to high school degree (or degree equivalent), some college and completed college or above; rank was coded for enlisted personnel as Junior (E1-E4), Mid-level (E5-E6) and Senior (E7-E9) and for Officers as Warrant Officer, O1 – O3, O4 – O5 and O6 – O11; total time in service at time of discharge was coded as less than 1 Year, 1+ to 2 years, 2+ to 3 years, 3+ to 4 years, 4+ to 5 years, 5+ to 7 years, 7+ to 10 years, 10+ to 15 years and greater than 15 years.

Data Analysis

Frequency distributions, percentages and odds ratios from unadjusted (univariate) logistic regression models are used initially to describe the demographic characteristics of soldiers discharged with a permanent disability.

Disability discharge rates were calculated by dividing the total number of active-duty soldiers discharged with a disability by the total number of soldiers on active duty during that year based on DMDC personnel file data. To control for temporal shifts in discharge from the army, we also examined disability discharge rates using total discharges from the Army in a given year as the denominator. Because trend lines were very similar when we used either total population or total discharges as the denominator, we only report findings using the population, instead of discharges, as the denominator with rates reported per 100,000 soldiers on active duty per year. This allows for greater comparability with non-military data.

To assess the influence of temporal changes in the Army's demographic profile on the annual disability rate, unadjusted disability discharge rates were plotted alongside rates that were adjusted for temporal changes in gender, race, age and time in service. Population rates were directly standardized to the 1981 population profile.

Autoregressive time series analytic models were used to assess temporal changes in the demographic profile of soldiers discharged with a disability for the years 1981 through 2005. In time series data, error terms may be serially correlated yielding bias in ordinary regression models. Autoregressive models correct for the autocorrelation between data in a related series (i.e., years 1982 through 2005). Stepwise autocorrelation selects the order of the autoregressive error model (i.e., AR1, first-order autocorrelations that adjust for the prior one year, AR2, second-order autocorrelations that adjust for two years prior). The Durbin-Watson test is used to test for the presence of autocorrelation; when it is not significant, the model has effectively reduced the bias due to autocorrelation. The ARCHTEST disturbances (i.e., Q statistics test and Lagrange Multiplier test) are used to test for heteroscedasticity of error variance (4).

When these statistics are not significant, the error variance is considered homoscedastic. Unless otherwise indicated, all models meet tests for autocorrelation and heteroscedasticity. In separate analyses years of study period (1981-2005) were regressed on rates of permanent disability per 100,000 population for females and whites and for mean age and mean total time in service (in months). Log transformation was applied and temporal estimates from the autoregressive models are interpreted in terms of percent change by taking the exponent of the obtained estimate

Analyses were conducted using SAS versions 8.2 and 9 (SAS Institute, Cary, NC) and Mplus version 4.2 (Muthén and Muthén, Los Angeles, CA). All analyses for this project adhere to the policies for the protection of human subjects as prescribed in Army Regulation 70-25, and with the provisions of 45 CFR 46.

Results

Between 1981 and 2005, there were 2,724,359 soldiers discharged from the Army and, of these, about 4% left the Army with a documented permanent disability (N = 108119). Despite downsizing of the overall military population, the frequency of disabilities actually has increased resulting in an alarming increase in the disability rate over the study period. While the overall Army population has been significantly reduced from 922, 448 in 1981 to 564, 802 in 2005 the number of disabilities each year has increased from 1,641 in 1981 to 7,126 in 2005.

The annual disability discharge rate per 100,000 population has increased by over 600% over the past 25 years (Figure 1). In 1981 the rate per 100,000 soldiers was 178/100,000 but by 2005 the rate had climbed to 1,262 per 100,000 soldiers. There was a temporary drop in disability rates per discharged soldiers in 1992 coinciding with extensive military downsizing occurring in this time period (1, 3, 21, 22) which would have increased the overall number of individuals discharged, presumably mostly without disability.

{INSERT FIGURE 1 HERE}

Table 1 describes the demographic characteristics of soldiers discharged with a permanent disability compared to those soldiers discharged from the military without a disability during the study period. Soldiers discharged with a permanent disability between 1981-2005 were more likely to be female, older than 21 and less than 40 (particularly age 31-35), married or previously married, mid-level or junior enlisted (as opposed to senior enlisted or officers) and they are significantly less likely to have a college education.

{INSERT TABLE 1 HERE}

Over the 25 year study period the overall demographic profile of the Army at large shifted, becoming more female (the proportion of female soldiers in the army increased from 10% in 1981 to 15% by 2005), less African American but more Hispanic and with greater representation of other minority racial/ethnic groups as well as greater proportions of officers and relatively fewer enlisted soldiers. There was a slight decline in the proportion of white soldiers (63% to 61%) and larger decline in African American soldier representation (29% to 22%) by the end of the study period. The Hispanic population increased from 4% to 11% and "other" racial and ethnic groups (as a whole) increased from 4% to 7%. The proportion of the population who were officers increased from 10% to 13% while the proportions of enlisted soldiers declined from 88% to 85%. The average age of the population has also increased and in particular the proportion of soldiers age 36 or older has increased while younger age groups have experienced a relative decrease. The average time in service of active duty soldiers has also shifted towards a greater proportion of soldiers remaining on active duty past 10 years. Between 1981 and 2005 the proportion of soldiers who had been on active duty for less than 2 years declined from 39% to 31%, those with 2-5 years or 6-10 years of total active service remained relatively stable (32% to 31% and 14% to 15% respectively between 1981 and 2005). Those with greater than 10 years of active service increased from 15% to 24% over the same time period. The percentage of soldiers with a college degree increased from 19% to 21% but the increase was not linear with proportions varying over the study period (Data not shown).

Because demographic factors such as gender and age are associated with disability, it is possible that the changing demographic profile of the Army at large may explain some of the changes in the disability rate over time. To assess this hypothesis, unadjusted disability rates per 100,000 population and disability rates adjusted for changes in gender, race, age and total time on active duty were plotted side by side (See Figure 2). The adjustment does not make much difference at all and explains none of the increasing risk of disability over the time period.

{INSERT FIGURE 2 HERE}

The lack of impact made by standardizing rates may be due to shifts in the relationship between certain demographic factors and risk of disability over time. In order to begin to understand the underlying etiology of the increasing disability rate, it is important to determine whether identified risk factors (Table 1) are constant OR, whether they, too, are changing. That is, is the overall face of disability changing in the Army? The following analyses address this question. Figures 3A, 3B and 3C show rates of disability over time by sub-population specific rates for gender, age and educational sub-groups. Disability rates for women and men are both trending up but since about 1990 the female disability rate per 100,000 women has been increasing at a faster pace than the male rate per 100,000 males on active duty (Figure 3A).

{INSERT FIGURE 3A HERE}

Figure 3B age-specific disability rates suggest an interaction between age and time. In the beginning of the study period, 21-30 year olds were among those at lowest risk for disability. But, by 1990 their risk had increased rapidly, surpassing all other age groups. In contrast, those over age 40 were initially at greatest risk but by the late 1990s their risk of disability had dropped to the very bottom of the group (Figure 3B).

{INSERT FIGURE 3B HERE}

College education appears to have an increasingly protective effect on disability (at least in analyses only adjusted for education, but not other factors often associated with education) (Figure 3C). Since about 1986, risk for disability among those without college education continued an upward trend started in 1981. But, those with a college education actually experienced a drop in disability followed by a relatively long period of stability. In the late 1990s, the rate of disability among those with a college degree also began to rise, but was still much lower than the rate among soldiers without a college degree

{INSERT FIGURE 3C HERE}

In addition to visual examination of rates for specific demographic sub-groups of the Army, we also explored temporal changes in the profile of those with disability using time series analytic models. The changing demographic profile of soldiers with disability in some cases mirrors the underlying changes in the total Army population, but in other cases is in direct contrast. The rate of permanent disability of female soldiers increased at the same time as the relative numbers of women increased. The rate of permanent disability of white soldiers increased at the same time as the relative numbers of white soldiers slightly decreased. There was a decline in the mean age and total time in service of soldiers discharged with a disability over the study. Thus even though the army at large is getting older and staying on active duty longer, the average age and tenure of those with a disability is getting younger and shorter, respectively. The results from the autoregressive time-series analysis models exploring temporal changes in the demographic profile of those with a disability-related discharge indicated that each of the time trend models for proportions of female and white soldiers, mean age and mean time in service are statistically significant. The positive association of the time trend for female gender indicates that the proportions of female soldiers increased by 10% with each increasing year (exponent [0.10*1.0] = 0.10). The positive association of the time trend for white race indicates that the proportions of white soldiers increased by 0.5% with each increasing year (exponent [0.005*1.0] = 0.05). Even though on average the Army got older during this study time period, the mean age as well as time in service of those discharged with a disability decreased over time. Mean age decreased by 0.38% and time in service decreased by 0.2% with each increasing year.

{INSERT TABLE 2 HERE}

In addition to assessing the population at risk and the demographic profile of those experiencing disability over time, it is important to document changes in the nature of disabilities experienced over the time period overall and within the high-risk subgroups. Approximately 71% of all disability discharges are related to the musculoskeletal system.. In addition, musculoskeletal-related disability is the fastest growing category of disability going from 70/100,000 in 1981 to 950 per 100,000 by 2005 (Data not shown). While it is beyond the scope of this descriptive analysis to assess all demographic factors by all VASRD groups, it is useful to demonstrate the importance of pursuing this line of research in future work. For example, if we focus in on musculoskeletal disability, versus all others, among one of the high risk demographic groups (women) we can see the importance of this analytic approach (see Figure 4). As Figure 4 visually demonstrates, the growing disability burden experienced by women appears to be primarily attributable to musculoskeletal disability.

{INSERT FIGURE 4 HERE}

Discussion

There have been large increases in the rates of disability discharge from the US Army over the past two decades. These changes are primarily driven by sharp increases in disability discharges related to musculoskeletal disorders. Overall disability rates for all causes combined are associated with demographic factors including female gender, married or formerly married marital status, less than a college degree, junior and midlevel enlisted rank. Relatively younger and shorter tenured soldiers are also at greater risk for experiencing disability, particularly in more recent years. However, this association should be interpreted with caution as eligibility for disability benefits is partially dependent upon tenure. Thus, the real relationship between time in service (and, indirectly, age) and disability cannot be fully evaluated without placing it in the context of eligibility for benefits and, possibly, related motivation to seek disability evaluation upon discharge from the Army.

Assessing the association between demographic risk factors and disability is complicated by changes in the overall army demographic profile as well as shifts in the risk profile over the study period. The army has become more female, older, more Hispanic and has shifted towards greater representation among officers and concurrent reductions in the relative proportions of enlisted soldiers. In addition, the overall size of the army has dropped by nearly 40% over the study period. Shifts in the proportion of soldiers by rank suggest that much of this reduction has occurred within the enlisted ranks. Given the growing risk of disability among enlisted, particularly younger or junior enlisted, it is possible that in fact military downsizing, concurrent with multiple deployments and other occupational stressors, may be contributing to the increasing disability rate within this demographic subgroup. This is an occupational cohort that needs further study in order to fully evaluate the etiology of this increase.

Though the army has become more female and disability risk is greater among female soldiers, adjusting for demographic changes, including greater representation of women, shift to an older population with fewer African Americans and more Hispanics, does not explain the increased risk for disability overall. This is due to several underlying phenomena. First, the risk of disability among women has increased independently of the population (i.e., the risk of disability among women per population of women has increased at the same time as the overall percentage of women in the Army at large has increased). Second, the average age of those with disability has decreased while the average age of the army at large has increased. More research is needed to understand the etiology of this shift in the profile of soldiers experiencing permanent disability. It is not clear, for example, how the nature of disability by demographic groups at risk, has changed. Preliminary findings (in unadjusted models) suggest that at least for gender, that while rates of musculoskeletal injury-related disability are increasing for both men and women, the increase is occurring at a more rapid pace among women.

The apparent protective effect of college education is worth further exploration. It is not clear whether this is related to a reduction in occupational exposures to certain risks which might correspond to different job opportunities available to soldiers with a college degree or whether it is more directly protective by improving resiliency or resistance to stress and/or improved self-care which might result in reduced risk for long-term disability. In addition, because this is a descriptive study and results are univariate (not adjusted for other factors) the protective effect of a college education, higher rank and, to some degree, older age, are likely interrelated making it difficult to parse out the unique contribution of the college degree alone.

It is not all bad news. Those over the age of 40 have seen a dramatic decline in their risk for disability. Soldiers who remain on active duty and who avoid serious injury or disease for 15 years appear likely to remain disability-free by the time they retire. This relative improvement in the health and well-being of older soldiers with longer tenure may reflect a healthy worker or “survivor” bias. Or, it could be due to changes in medical care and screening that has resulted in a reduced overall risk for cardiovascular diseases. The primary underlying cause of increased disability is occurring within the musculoskeletal injury and disease category.

Conclusion

Little research has been published describing the population of soldiers who leave the US Army with a permanent disability. Even less is known about the underlying causes of these disabilities. Yet, disability rates are increasing rapidly resulting in huge economic losses to the U.S. government and, ultimately, the tax payer. In addition, and more importantly, more than 7000 people are now being discharged per year from the army with a life-altering disability.

Changes in the underlying Army population demographics over time do not explain the overall increased risk in disability. While increases in disability risk are generally being experienced across all military demographic groups, the subgroups with the fastest growing rates are women, junior enlisted and younger soldiers. The primary cause of these disabilities appears to be injury or the adverse effects of acute and chronic injury and related conditions. While more research is needed to understand the underlying causes of these conditions, the changing profile of disability suggests that key demographic groups to focus on include women, younger soldiers, junior or mid-level enlisted solders, and those with less than a college education.

Future research should include multivariate predictive models to assess the independent effect of gender, education, rank and age. These models will need to control for changing temporal patterns (interactions) (e.g., increasing risk among women over time, decreasing risk for older age, increasing protective effect of college education) and potential interactions between risk factors (e.g., gender and age interactions) (25). Future analyses should also assess associations with particular types of disability and clarify patterns of risk for different types of disability within high-risk subgroups as well as risk factors for different types of disability. Models will need to control for variations in disability eligibility (e.g., time in service). Ultimately, results from this and future research efforts should to be used to inform interventions with well-conceived evaluation plans in order to assess effectiveness in reducing the economic cost and burden of disability.

Tables and Figures

Figure 1. Rate of permanent disability per 100,000 population and per 10,000 discharges from the U.S. Army, 1981-2005.

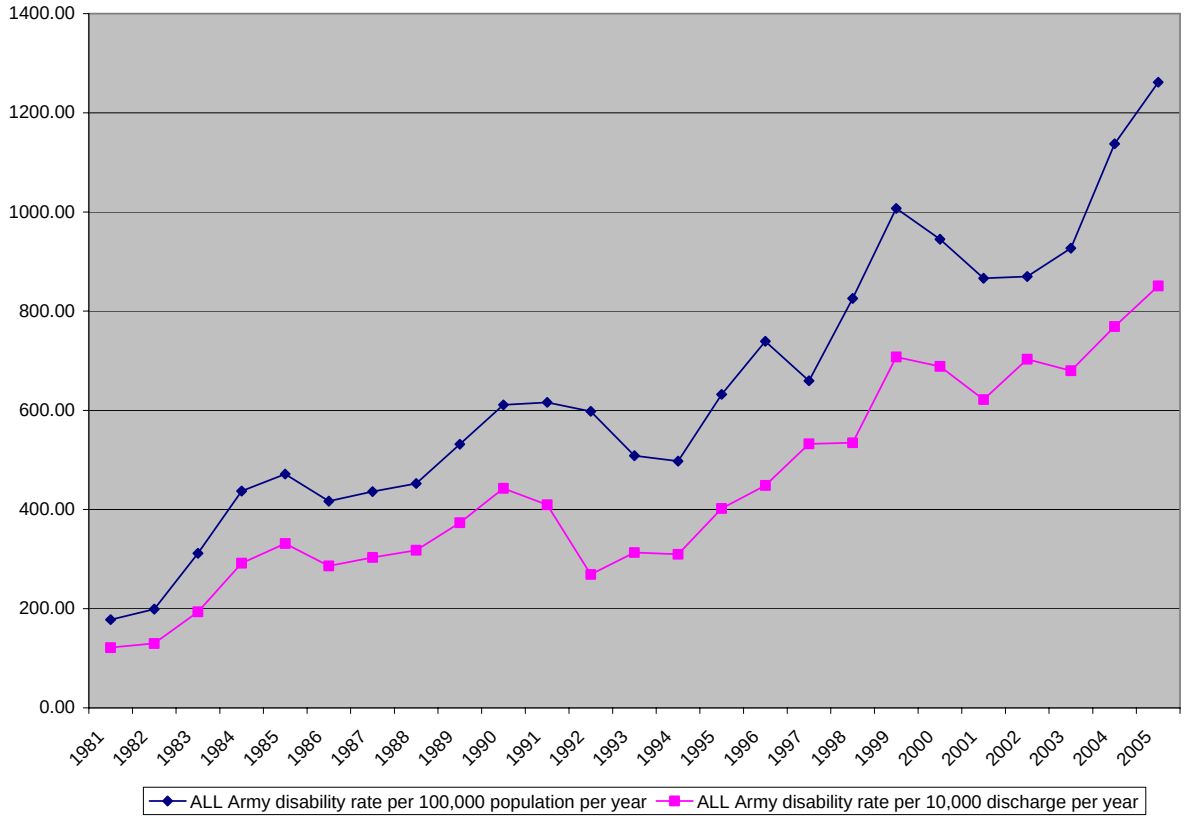
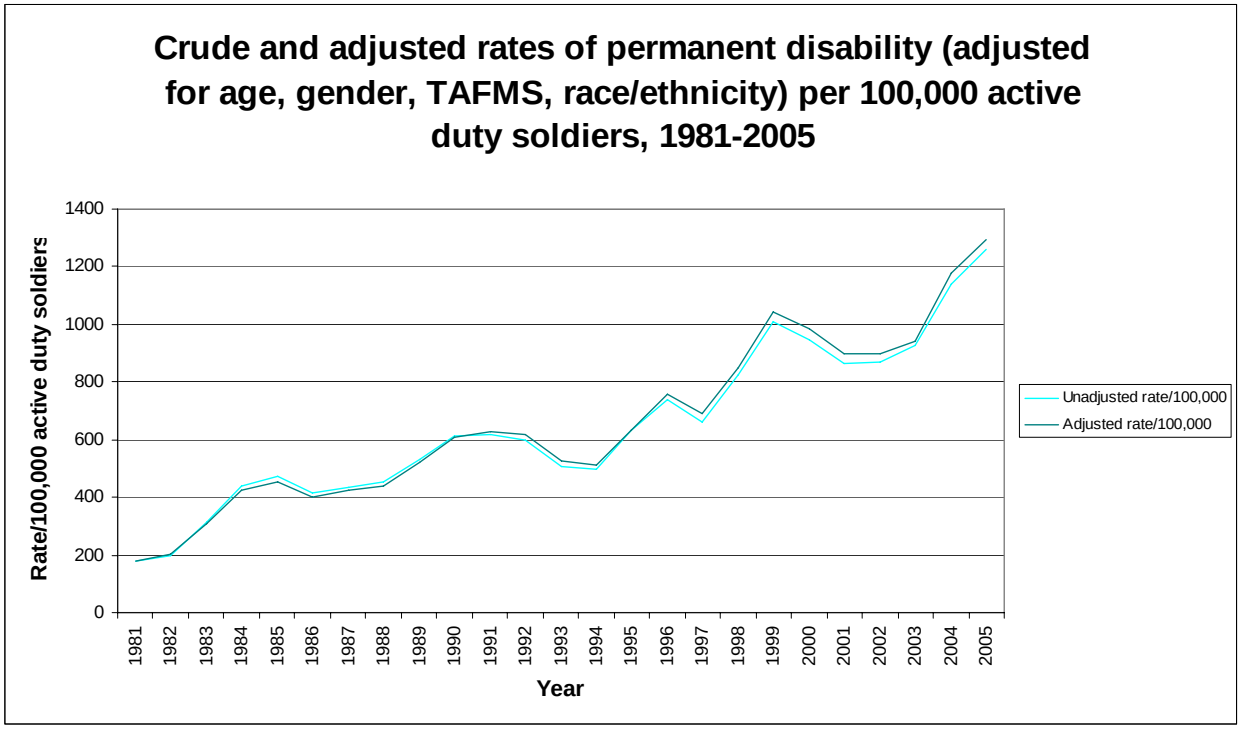


Table 1. Demographic characteristics of discharged soldiers with and without permanent disability*; unadjusted odds ratios from logistic regression models

Characteristic	Without Disability	With Disability	OR	95% CI
Gender				
Men (%)	96.22	3.78	1.00	
Women (%)	94.85	5.15	1.37	1.35-1.39
Age				
< 21	97.21	2.79	1.00	
21-25	96.68	3.32	1.18	1.16-1.20
26-30	94.53	5.47	1.97	1.93-2.02
31-35	92.26	7.74	2.85	2.78-2.92
36-40	95.32	4.68	1.68	1.63-1.73
>40	97.20	2.80	0.97	0.94-1.00
Race				
White	96.02	3.98	1.00	
Black	96.04	3.96	1.00	0.98-1.01
Hispanic	95.84	4.16	1.01	0.99-1.04
Other	96.48	3.52	0.94	0.92-0.97
Marital Status				
Single	96.97	3.03	1.00	
Married	95.04	4.96	1.69	1.68-1.71
Previously married	94.57	5.43	1.83	1.77-1.89
Education				
<=highschool	95.87	4.13	1.00	
Some college	95.64	4.36	1.07	1.04-1.10
College degree or greater	97.08	2.92	0.69	0.67-0.71
Rank				
Junior enlisted (E1-E4)	96.23	3.77	1.00	
Midlevel enlisted (E5-E6)	94.23	5.77	1.55	1.53-1.57
Senior enlisted (E7-E9)	96.94	3.06	0.80	0.78-0.82
Warrant officer	96.95	3.05	0.65	0.61-0.70
Junior officer (O1-O3)	97.37	2.63	0.65	0.63-0.68
Midlevel officer (O4-O5)	98.49	1.51	0.39	0.36-0.41
Senior officer (O6-O11)	98.44	1.56	0.40	0.35-0.45
Time in service				
< 1 year	97.16	2.84	1.00	
1-2 years	94.77	5.23	2.01	1.96-2.06
>2-3 years	97.01	2.99	1.11	1.08-1.13
>3-4 years	97.22	2.78	1.04	1.01-1.06
>4-5 years	94.97	5.03	1.91	1.86-1.97
>5-7 years	94.68	5.32	2.01	1.95-2.06
>7-10 years	93.94	6.06	2.34	2.28-2.41
>10-15 years	91.81	8.19	3.24	3.16-3.33
>15 years	97.43	5.57	0.95	0.92-0.97

* Excludes soldiers discharged with temporary disability (TDRL) from analysis

Figure 2. Adjusted and unadjusted disability per 100,000 population rates, 1981-2005



* Rates standardized (adjusted) to 1981 demographic composition

Figure 3A. Gender-specific disability rate per 100,000 population, 1981-2005

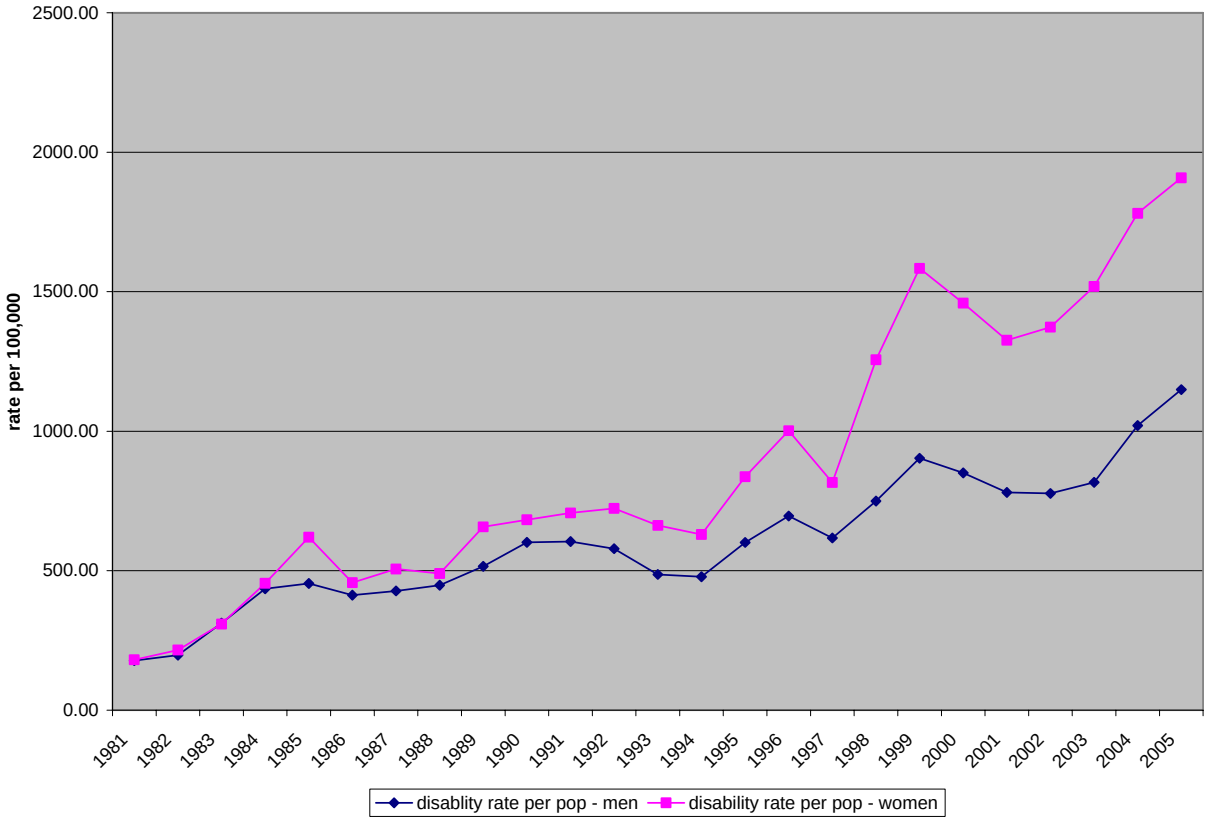


Figure 3B. Age-specific disability rate per 100,000 population, 1981-2005

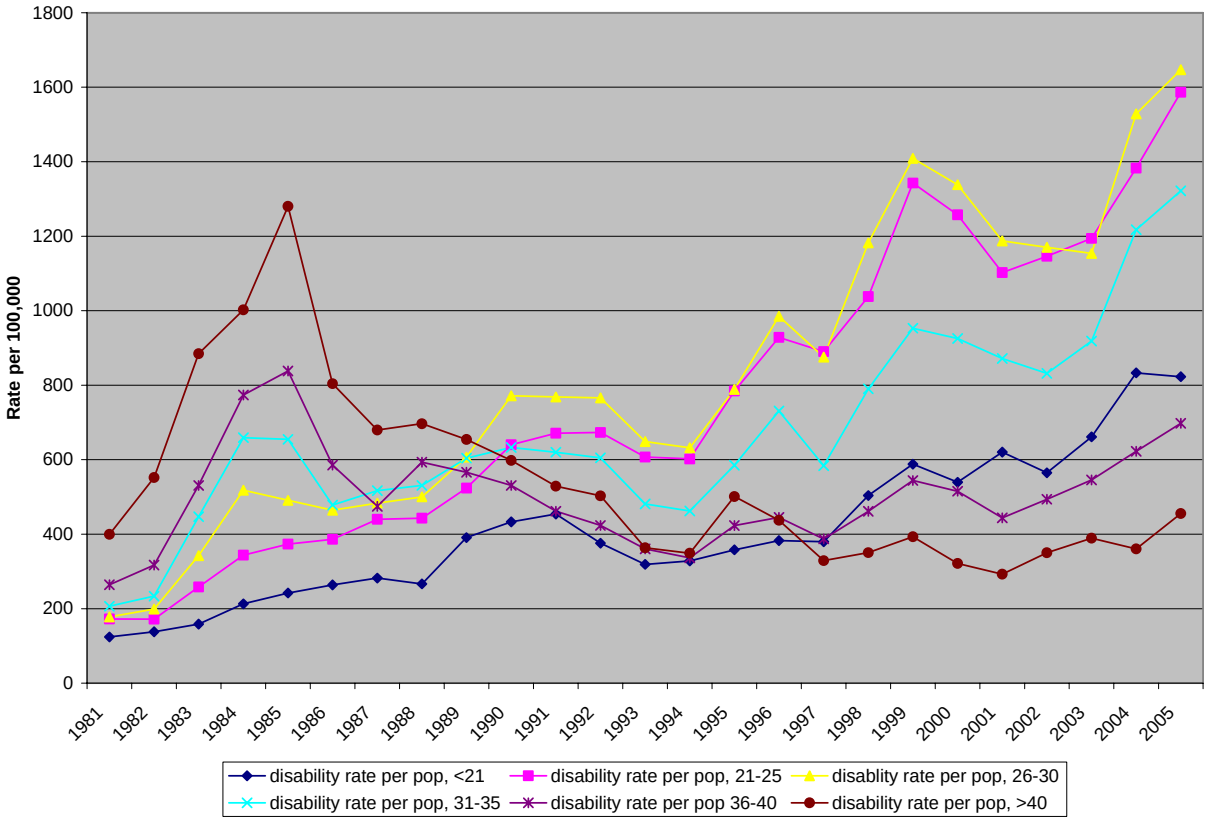


Figure 3C. Education-specific disability rate per 100,000 population, 1981-2005.

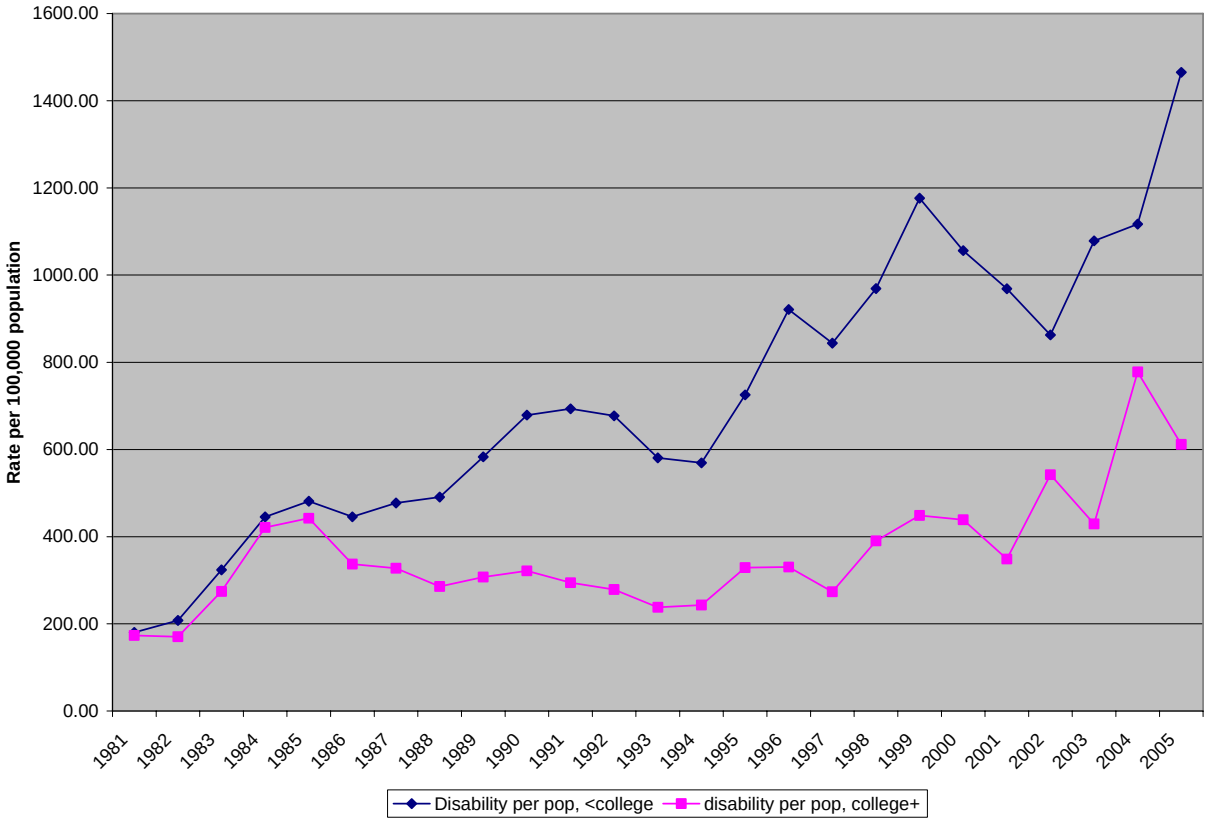
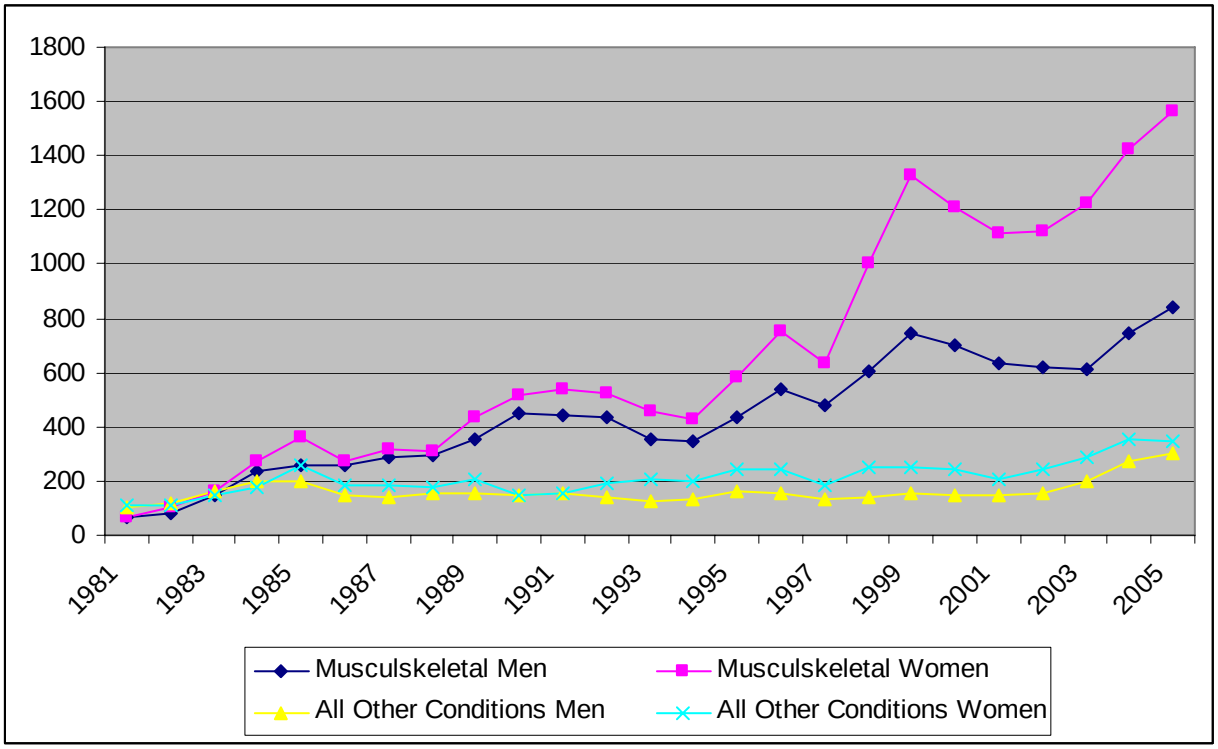


Table 2. Time series estimates for demographic factors related to disability discharges among soldiers for the years 1981 through 2005.*

	Variables	Estimate	S.R.	t	p	Durbin-Watson	Bera-Jacque	R^2
Female Gender	Intercept	-203.08	14.50	-14.00	<.0001	1.95 (ns)	0.03 (ns)	.96
	Year	0.104	0.007	14.32	<.0001			
	AR(1)	-0.775	0.209	-3.70	.0001			
	AR(2)	0.39	0.202	1.93	.07			
White race	Intercept	-103.81	10.91	-9.52	<.0001	1.69 (ns)	2.93 (ns)	.94
	Year	0.055	0.005	10.07	<.0001			
	AR(1)	-1.07	0.167	-6.44	<.0001			
	AR(2)	0.73	0.138	5.28	<.0001			
Mean age	Intercept	10.84	1.24	8.71	<.0001	2.05 (ns)	2.32 (ns)	.80
	Year	-0.0038	0.0006	-6.05	.0003			
	AR(1)	-0.65	0.221	-2.95	.008			
	AR(2)	.38	0.204	1.87	.08			
Mean time in service	Intercept	47.11	4.42	10.65	<.0001	2.08 (ns)	4.01 (ns)	.90
(in months)	Year	-0.022	0.002	-9.68	<.0001			
	AR(1)	-0.645	0.222	-2.90	<.008			
	AR(2)	0.398	0.199	2.00	<.058			

*AR=auto-regressive estimate, which log-transformed the series data.
ns=not statistically significant

Figure 4. Musculoskeletal versus all other causes of disability (1981-2005) by gender: rates per 100,000 gender-specific population denominators



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Appendix B

USARIEM Human Use Review Committee

CONTINUING REVIEW REPORT

In accordance with Federal Regulations 45CFR46, the Human Use Review Committee must review protocols at least annually or more frequently to approve human subject involvement. Please complete this form and return to ORQC.

Protocol Number: USARIEM H00-10y, HSRRB A-13630 Date of this Report: July 20, 2006

Principal Investigator: Dr. Carolyn Schwartz

INITIAL HURC REVIEW DATE 16 August 2005

PREVIOUS CONTINUING REVIEW DATE N/A

THIS REPORT COVERS THE PERIOD 16 August 2005-July 20, 2006

Title: Risk factors for discharge from the Army with a permanent disability

PROTOCOL SUMMARY:

This research focuses on risk factors for permanent disability discharge in active duty Army personnel. The main hypothesis is that disability results from a combination of health, occupational, and personal factors that can be identified prior to the onset of a potentially disabling condition. It is further hypothesized that many of these factors are modifiable. Understanding the factors associated with an increased risk for medical disability discharge or retirement is necessary in order to develop targeted and cost-efficient disability reduction strategies and manage the conditions that may eventually lead to permanent disability and the premature loss of active duty soldiers.

1. Number of VOLUNTEERS REQUESTED in the APPROVED protocol: N/A
2. DURING THIS REPORTING PERIOD I HAVE ENROLLED _____ VOLUNTEERS.

   I PLAN TO ENROLL MORE VOLUNTEERS Y/N
3. Please complete the following table:

	Number of volunteers Male/Female
VOLUNTEERS INITIATED into the study FOR THIS REPORTING PERIOD	N/A
VOLUNTEERS WITHDRAWN or withdrew THIS REPORTING PERIOD*	N/A
VOLUNTEERS COMPLETING TESTING TOTAL TO DATE	N/A

*Reasons for withdrawals_____

4. List and briefly describe all ADVERSE EVENTS FOR THIS REPORTING PERIOD:
   Date | Adverse Event | Description
   N/A

5. New developments or publications influencing volunteer participation or risk
   Summarize the new development(s) and/or reference literature source and title.
   N/A

6. List AMENDMENTS made to the research FOR THIS REPORTING PERIOD:
   Date | Amendment Number | Description
   N/A

7. List DEVIATIONS occurred during research FOR THIS REPORTING PERIOD:
   Date | Description
   N/A

8. Are the research files and laboratory notebook being maintained in accordance with USARIEM-Memo 70-25 and 70-55: N/A

9. Are the files and laboratory notebook ready for periodic review? N/A

   Where is data stored, if laboratory notebook is not use? N/A

10. Use a separate SHEET TO SUMMARIZE FINDINGS reported to date
    See attached

11. List PUBLICATIONS, PRESENTATIONS, and ABSTRACTS resulting from this study.
    Please provide complete citations. If there have been none, please indicate.
    None

ATTACHMENTS:
Copy of CURRENT SIGNED PRIVILEGE REVIEW SHEET

7/20/06
Principal Investigator/ Date

7/20/06
Division Chief / Date

8/4/06
HURC Reviewer / Date

8/7/06
Allen Cymerman, Ph.D. / Date
HURC Chair

8/7/06
KARL E. FRIEDL, COL, MS / Date
USARIEM Commander

H00-10y. Risk Factors for discharge from the Army with a permanent disability.
HSRRB A-13630
PI: Dr. Carolyn Schwartz

This research protocol was submitted to the USARIEM HURC for review in August 2005. It was then sent to HSRRB for review and comments. All revisions pertaining to HSRRB comments were addressed and incorporated into the research protocol and the study was officially approved on 16 March 2006. A memo signed 18 May 2006 by USARIEM Commander, COL Karl Friedl documents this approval.

In March of 2006, a memo was submitted by Social Sectors Development Strategies, Inc. to USAMRAA to officially change the Principal Investigator of this research from Dr. Katy Benjamin to Dr. Carolyn Schwartz. Once the change was implemented with the funding agency, a letter was sent to the USARIEM HURC on 10 May 2006 to document this change.

Actual work on this grant was not scheduled to begin until 1 July 2006. Since this start date, work has focused on administrative and staffing issues. No work has been performed to report thus far.